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KENNEDY SPACE CENTER, FLORIDA 32899

OCTOBER 18, 1991

REPORT NUMBER 91-4821

SUBJECT: FINAL REPORT ON PROTECTIVE COATING SYSTEMS FOR CARBON STEEL EXPOSED TO SIMULATED SOLID ROCKET BOOSTER (SRB) EFFLUENT - 60 MONTH EXPOSURE

- RELATED DOCUMENTATION:
- (1) MTB-268-86, A, B, AND C
 - (2) KSC-STD-C-0001B, Protective Coating of Carbon Steel, Stainless Steel, and Aluminum on Launch Structures and Ground Support Equipment, Standard for, July 1987.
 - (3) NASA-TN-7336, "Performance Characteristics of Zinc-Rich Coatings Applied to Carbon Steel", W. Paton, July 1973.

1.0 FOREWORD

The intent of this report is to document the 60 month performance of coating systems initially exposed at the Kennedy Space Center (KSC) Beach Corrosion Site on May 14, 1986. This test program was started to determine alternative topcoats for use on inorganic zinc to increase chemical resistance to the Space Transportation System (STS) launch environment. KSC-STD-C-0001 requires an evaluation at the 60 month exposure period for material evaluation for final approval of products. This report will serve as information to provide input for development of Appendix A and B for coating systems listed in KSC-STD-C-0001.

2.0 INVESTIGATIVE PROCEDURE

2.1 A list of the materials tested is shown in Table I.

2.2 The exposure testing for this study was conducted at the KSC Beach Corrosion Test Site. This site is located approximately 1.5 miles South of Launch Complex 39A. The coated test panels were installed on a stainless

steel rack that uses porcelain insulators as standoffs. Each rack can hold up to 25 panels; however, not all racks were completely filled. The racks were installed on galvanized pipe test stands at a 30° angle facing the ocean. The distance of the test stands from the mean high-tide line was approximately 100 feet. Views of the test site are shown in Figures 1 and 2.

- 2.3 Seven different conditions were used in the field exposure testing: (1) untopcoated inorganic zinc panels exposed to normal marine conditions, (2) thin film topcoats over zinc panels exposed to normal marine conditions, (3) high build topcoats over zinc panels exposed to normal marine conditions, (4) vendor recommended topcoats over zinc exposed to normal marine conditions, (5) thin film topcoats over zinc panels exposed to normal marine conditions plus Al_2O_3 slurry applications, (6) high build topcoats over zinc panels exposed to normal marine conditions plus Al_2O_3 slurry applications, (7) vendor recommended topcoats over zinc panels exposed to normal marine conditions plus Al_2O_3 applications. The slurry was composed of 0.3 micron Al_2O_3 particles in a 10% hydrochloric acid (HCl) solution. This slurry was periodically applied to the lower 2/3 of the panels using a polyethylene squeeze bottle.
- 2.4 Three materials not on the original product list were exposed during the study for performance testing, but only one was tested in the topcoated condition. Napko 22, a single component, organic zinc rich phenoxy, was tested as a control and was topcoated for comparison. Pur-Zinc ME III, an organic, moisture-cured urethane zinc-rich primer was exposed in January 1987 and not exposed in the topcoated condition. This material is manufactured by the Pure Cote Corporation. A newly formulated Ameron D-6, an inorganic zinc-rich primer manufactured by the Ameron Corporation, was exposed in May 1989 but not topcoated. The ratings of these materials at the respective exposure times are also presented but not included in system averages.
- 2.5 Additionally, panels were prepared with a single package inorganic zinc rich primer (Subox Galvanox IV) as a control based on past performance in a previous study. One panel of each inorganic zinc primer was prepared using an inorganic topcoat (Ameron 741) to evaluate the performance of this material versus the organic topcoats involved in this study. The heat resistance of this topcoat has allowed its use in areas that receive rocket exhaust damage during launch.
- 2.6 The test panels were examined on June 26, 1991, making the exposure duration of the original materials just

over 60 months. The results of the seacoast exposure are shown in Tables II, III, IV, and V. The degree of corrosion was judged on a scale of 0 to 10, with 10 being the highest rating. This rating system is described in ASTM D610 as follows:

<u>RATING</u>	<u>DESCRIPTION</u>
10	No rusting or less than 0.01% of surface rusted.
9	Minute rusting, less than 0.03% of surface rusted.
8	Few isolated rust spots, less than 0.1% of surface rusted.
7	Less than 0.3% of surface rusted.
6	Extensive rust spots, but less than 1% of surface rusted.
5	Rusting to the extent of 3% of surface rusted.
4	Rusting to the extent of 10% of surface rusted.
3	Approximately 1/6 of the surface rusted.
2	Approximately 1/3 of the surface rusted.
1	Approximately 1/2 of the surface rusted.
0	Approximately 100% of the surface rusted.

The panels used for coating testing have approximately 32 square inches of exposed area: This calculates to 0.0096 square inches for a rating of "9," 0.032 square inches for a rating of "8," 0.096 square inches for a rating of "7," and so on for the other area amounts.

- 2.7 According to the regulations stated in KSC-STD-C-0001, an inorganic zinc coating must receive a corrosion rating of 9 or better after 18 months of beach exposure. This is the requirement an inorganic zinc coating must meet to be accepted for the approved products list at KSC. Further, the coating must continue to perform to this level for 5 years (60 months) to remain on the approved list. If during this 5 year period a coating drops below the corrosion rating of 9, it is immediately removed from the approved products list.

Similarly, it has been decided to require that a topcoated inorganic zinc primer must receive a corrosion rating of 8 or better after 18 months of normal beach exposure to be initially approved. This coating system must continue to perform at this level for 5 years (60 months) to remain on the approved topcoat list in KSC-STD-C-0001.

- 2.8 The acronyms used for the material identification in the tables are as follows:

KEY TO TEST MATERIALS

Carbon Steel Coatings:

IZ-1	One-component solvent based inorganic zinc.
IZ-2	Two-component solvent based inorganic zinc.
VBN-EU	Vendor's inorganic zinc + same vendor's epoxy/urethane.
VEN-HBEU	Vendor's inorganic zinc + same vendor's high build epoxy/urethane
VEN-REC	Vendor's inorganic zinc + same vendor's recommended alternative to epoxy/urethane.
VEN-IO	Vendor's inorganic zinc + Amercoat 741

3.0 RESULTS

- 3.1 All rating values presented in the tables are an average of four panels prepared and exposed at the same time. Where the ratings differed from panel to panel, a simple arithmetic mean is reported.
- 3.2 At the 60 month evaluation, most of the inorganic zinc-rich coating systems are performing well. With the exception of Byco SP-101, Coronado 935-152, Devoe Prufcoat ZP-500, Glidden 5536 and 5530, Koppers 701, Subox Galvanox IV and V, and Tnemec 90E-75, all the two-component inorganic zincks exposed to normal conditions at the beach corrosion site are continuing to perform acceptably at 60 months. By contrast, the two single-component organic zinc-rich products, Pur-Zinc ME III and Napko 2Z, performed poorly in the KSC marine environment. This further confirms the findings presented originally in 1973 by NASA TN-D-7336, that as a class, the organic zinc products do not perform as well as the inorganic type products.

- 3.3 In general, the panels with the epoxy/polyurethane topcoats are continuing to degrade much faster than the bare zinc primer panels. However, a few manufacturer's topcoat systems are performing well in the normal exposure conditions. In particular, the following product combinations are performing at a level of "8" or above after 60 months of exposure.

<u>MANUFACTURER</u>	<u>ZINC PRIMER</u>	<u>EPOXY TIE COAT</u>	<u>URETHANE</u>
DEVOE-MARINE	304	201	239
DEVOE-MARINE*	304	230	249
DEVOE-MARINE*	304	201	249
DEVOE-PRUFCOAT	ZP-500	545	369
ENGARD	519	1447	428
ENGARD*	519	1447	449
PORTR*	ZL-311	MCR-43	8610
PORTR*	ZL-311	MG-77	4610
PPG*	1001	97-139	97-812
PPG*	1001	97-148	97-812
RUSTOLEUM*	5686	95-1501	9400
SIGMA*	7551	5434	7523

* - designates high build coating system

This finding demonstrates that just like the varying performance of the bare zinc primers, the three-coat topcoat systems are product-specific for long term performance. This characteristic of the coating systems shows the need to develop a separate list in KSC-STD-C-0001 to identify approved topcoat products when specifying corrosion control with the three-coat system.

- 3.4 In contrast to the findings at the 18 month evaluation, the panels receiving the simulated SRB effluent spray are deteriorating much faster at 60 months than the normal exposure panels. As shown by the average of all panels after over 70 acid sprays with the 10% HCl/alumina mixture, the acid treated panels have lower ratings than the duplicate normal exposure panels.
- 3.5 The purpose of this study was to determine if the higher build topcoat products would increase corrosion resistance to the KSC marine environment. From the exposure to date, differences were measured when comparing averages of all panels of VEN-EU and VEN-HBEU that demonstrates some improvement in corrosion resistance. This is shown at the bottom of Table VI. The average numbers are possibly closer than they should be due to several individual products performing poorly that lowers the overall average of the topcoat system. However, when looking at the individual materials listed in 3.3, 9 of the 12 satisfactory topcoat products are

high build type materials. This indicates that the high build products do provide increased corrosion resistance especially when subjected to the highly corrosive conditions of KSC seacoast exposure.

- 3.6 The panels coated with the inorganic topcoat (Ameron 741) performed much better than the organic topcoated panels. As can be seen from the results in Table VI, the panels exposed to the normal exposure conditions at the beach corrosion site nearly all rated a perfect "10." The system average of the normally exposed panels is higher than the inorganic zinc primer in the untopcoated condition. This material demonstrates the exception to the finding that a topcoating of inorganic zinc rich primers degrades the performance of the primer. The duplicate panels exposed to the acid sprays did not perform as well, but the system average shows they performed better than their organic topcoat counterparts in most cases. The success of these panels could be due to the porous nature of the inorganic topcoat and its inherent compatibility with the inorganic zinc primer silicate vehicle. It does not isolate or insulate the zinc rich primer underneath as completely as the organic topcoats. This allows the galvanic properties of the zinc primer to continue to protect the carbon steel substrate.
- 3.7 Progress of this testing program has been documented by color photographs at three stages of exposure (initial, 18 months, and 60 months). The 60 month photographs with the product identification key are located in the Appendix.

4.0 CONCLUSIONS

- 4.1 One additional inorganic zinc coating that passed the 36 month evaluation has now failed after 60 months. This coating is identified as Subox Galvanox IV.
- 4.2 Only three of the inorganic zinc primers still rate a 10 after 60 months. These products are identified as Carboline CZ-11, Devoe Catha-coat 304, and Engard 519.
- 4.3 The single-component organic zinc products, Pur-Zinc ME III and Napko 22, did not perform well in the KSC marine environment.
- 4.4 The untopcoated inorganic zinc panels continue to perform better than panels receiving organic topcoats. The use of organic topcoats leads to the localized failure of the inorganic zinc primer that causes the premature failure of the coating system.

- 4.5 The high-build organic topcoat systems are generally performing better than the thin film organic systems when exposed to the KSC marine environment.
- 4.6 The performance of a bare zinc primer is not always consistent with the performance of the topcoated system. In most cases this is due to the degradation of the performance of the underlying primer by the addition of a topcoat. Another list will be incorporated in KSC-STD-C-0001 to identify products that are approved when specifying the three coat system for use at KSC.
- 4.7 The performance of the panels coated with the inorganic topcoat performed very well with nearly all rating a perfect "10" in the normal exposure testing. Even when subjected to the acid sprays, the system averages are much higher than with the organic topcoats. This topcoat material actually enhances the performance of the inorganic zinc rich primer underneath. This is opposite to the finding generally found for the organic topcoat products.
- 4.8 The original intent of this study was to identify topcoat products to improve chemical resistance. Due to the poor performance of the topcoat systems in the acid exposure, the conclusions are based on normal marine exposure of the KSC Beach Corrosion Test Site. This result may require further testing of topcoat products in the future.

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TABLE I

1 ONE-COMPONENT INORGANIC ZINC COATING (IZ-1)

<u>MANUFACTURER</u>	<u>ZINC COATING</u>
SUBOX	GALVANOX IV

25 TWO-COMPONENT INORGANIC ZINC COATINGS (IZ-2)

<u>MANUFACTURER</u>	<u>ZINC COATING</u>
AMERON	D-6N
AMERON	D-9
BYCO	SP-101
CARBOLINE	CZ-11
CEILCOTE	200
CON-LUX	ZINC PLATE 21
CORONADO	935-152
DEVOE-MARINE	CATHA-COAT 304
DEVOE-PRUFCOAT	ZINC PRIME 500
DuPONT	GANICIN
ENGARD	519
GLIDDEN	GLID ZINC-5530
GLIDDEN	GLID ZINC 5536
INTERNATIONAL	INTERZINC 22
KOPPERS	701
MOBIL/VALSPAR	13-F-12
NAPKO	5-z
PORTER	ZINC LOCK 311
PPG	METALHIDE 1001
RELIANCE	REL-ZINC 100
RUSTOLEUM	5686
SHERWIN WILLIAMS	ZINC CLAD B69-V-1
SIGMA	7551
SUBOX	GALVANOX V
TNEMEC	903-75

TABLE I (Cont)

26 EPOXY/URETHANE TOPCOAT SYSTEMS (VEN-EU)

<u>MANUFACTURER</u>	<u>ZINC PRIMER</u>	<u>EPOXY TIE COAT</u>	<u>URETHANE</u>
AMERON	D-6N	182	450GL
AMERON	D-9	182	450GL
BYCO	SP-101	300HB	450
CARBOLINE	CZ-11	193LF	134
CEILCOTE	200	675	420
CON-LUX	ZP-21	20	200
CORONADO	935-152	101-147	827-1
DEVOE-MARINE	304	201	239
DEVOE-PRUFCOAT	ZP-500	545	369
DUPONT	GANICIN	CORLAR B.B.	IMRON
ENGARD	519	1447	428
GLIDDEN	5530	5461	6200
GLIDDEN	5536	5461	6200
INTERNATIONAL	IZ-22	INTERGARD	INTERTHANE
KOPPERS	701	654	1122 BRS
MOBIL/VALSPAR	13-F-12	13-R-60	40 SERIES
NAPKO	5-z	516	290
PORTER	ZL-311	MCR-43	4610
P P G	1001	97-3	97-812
RELIANCE.	RZ-100	59-ZP	300
RUSTOLEUM	5686	M9373	9400
SHERWIN WILLIAMS	B69-V-1	TILE CLAD	POLANE
SIGMA	7551	5434	7523
SUBOX	GALVANOX IV	A 8051	3000
SUBOX	GALVANOX V	A 8051	3000
TNEMEC	903-75	66	70 SERIES

TABLE I (Cont)

26 HIGH BUILD EPOXY/URETHANE SYSTEMS (VEN-HBEU)

<u>MANUFACTURER</u>	<u>ZINC PRIMER</u>	<u>EPOXY TIE COAT</u>	<u>URETHANE</u>
AMERON	D-6N	383HS	AMERSHIELD
AMERON	D-9	383HS	AMERSBIELD
BYCO	SP-101	300HB	451
CARBOLINE	cz-11	190HB	133HB
CEILCOTE	200	690	470
CON-LUX	ZP-21	39	200
CORONADO	935-152	111-111	827-1
DEVOE-MARINE	304	230	249
DEVOE-PRUFCOAT	ZP-500	547	359
DUPONT	GANICIN	CORLAR HB	IMRON HB
ENGARD	519	1447	449
GLIDDEN	5530	5555	G-THANE HB
GLIDDEN	5536	5555	G-THANE HB
INTERNATIONAL	IZ-22	I-GARD HB	I-THANE HB
KOPPERS	701	HIGARD	1122 BRS
MOBIL/VALSPAR	13-F-12	78-D-7	41 SERIES
NAPKO	5-z	520	295
PORTER	ZL-311	MCR-43	8610
PPG	1001	9 7 - 1 3 9	97-812
RELIANCE	RZ-100	RF-70	320
RUSTOLEUM	5686	9582 HB	9400
SHERWIN WILLIAMS	B69-V-1	E102	E106
SIGMA	7551	5434	7523
SUBOX	GALVANOX IV	8500	3100
SUBOX	GALVANOX V	8500	3100
TNEMBC	903-75	66	73 SERIES

TABLE I (Cont)

1.3 RECOMMENDED SYSTEMS (VEN-REC)

<u>MANUFACTURER</u>	<u>ZINC PRIMER</u>	<u>MID COAT</u>	<u>TOP COAT</u>
AMERON	D-6N	400	AMERSHIELD
AMERON	D-9	400	AMERSHIELD
CARBOLINE	CZ-11	188HB	133HB
CON-LUX	ZP-21	MB47/V93	VINYL 98
DEVOE-MARINE	304	201	249
DuPONT	GANICIN	CORLAR HB	IMRON
INTERNATIONAL	IZ-22	TAA-423	INTERTHANE
MOBIL/VALSPAR	13-F-12	VINYL 83	VINYL 22
PORTER	ZL-311	MG-77	4610
PPG	1001	97-148	97-812
RUSTOLEUM	5686	95-1501	9400
SUBOX	GALVANOX IV	A 4551	3100
SUBOX	GALVANOX V	A 4551	3100

TABLE I (Cont)

23 INORGANIC TOPCOAT SYSTEMS (VEN-10)

<u>MANUFACTURER</u>	<u>ZINC PRIMER</u>	<u>INORGANIC TOPCOAT</u>
AMERON	D-6N	AMERON 741
AMERON	D-9	AMERON 741
BYCO	SP-101	AMERON 741
CARBOLINE	CZ-11	AMERON 741
CEILCOTE	200	AMERON 741
CON-LUX	ZP-21	AMERON 741
CORONADO	935-152	AMERON 741
DEVOE-PRUFCOAT	ZP-500	AMERON 741
DUPONT	GANICIN	AMERON 741
ENGARD	519	AMERON 741
GLIDDEN	5530	AMERON 741
GLIDDEN	5536	AMERON 741
INTERNATIONAL	IZ-22	AMERON 741
KOPPERS	701	AMERON 741
MOBIL/VALSPAR	13-F-12	AMERON 741
NAPKO	5-z	AMERON 741
PORTER	ZL-311	AMERON 741
RELIANCE	RZ-100	AMERON 741
SHERWIN WILLIAMS	B69-V-1	AMERON 741
SIGMA	7551	AMERON 741
SUBOX	GALVANOX IV	AMERON 741
SUBOX	GALVANOX V	AMERON 741
TNEMEC	903-75	AMERON 741

TABLE II

RUST GRADE EVALUATIONS AFTER 60-MONTH SEACOAST EXPOSUREASTM D-610-68(74) RUST GRADES*

<u>COATING SYSTEM</u>	<u>PANEL RATING</u>
IZ-1 SUBOX GALVANOX IV	8.75
IZ-2 AMERON D-6N	9.88
AMERON D-9	9.25
BYCO SP-101	8.13 *
CARBOLINE CZ-11	10.00
CEILCOTE 200	9.38
CON-LUX ZINC PLATE 21	9.88
CORONADO 935-152	5.25
DEVOE-MARINE CATHA-COAT 304	10.00
DEVOE-PRUFCOAT ZINC PRIME 500	8.13
DUPONT GANICIN	9.63
ENGARD 519	10.00
GLIDDEN GLIDZINC 5530	8.50
GLIDDEN GLIDZINC 5536	2.00
INTERNATIONAL INTERZINC 22	9.25
KOPPERS 701	7.00
MOBIL/VALSPAR 13-F-12	9.38
NAPKO 5-Z	9.13
PORTER ZINC LOCK 311	9.63
PPG METALHIDE 1001	9.75
RELIANCE REL-ZINC 100	9.63
RUSTOLEUM 5686	9.63
SHERWIN WILLIAMS B69-V-1	9.88
SIGMA 7551	9.88
SUBOX GALVANOX V	2.75
TNEMEC 903-75	7.00
PUR-ZINC ME III (ORGANIC)	5.50 *
NAPKO 2Z (ORGANIC)	4.50
AMERON D-6	10.00 **

* = EXPOSED 1/87

** = EXPOSED 5/89

TABLE III

RUST GRADE EVALUATIONS AFTER 60-MONTH SEACOAST EXPOSURE
ASTM D-610-68(74) RUST GRADES*

<u>VEN-EU COATING SYSTEM</u>	<u>NORMAL EXPOSURE</u>	<u>ACID TREATED</u>
D-6N/182/450GL	6.25	4.75
D-9/182/450GL	6.00	6.25
SP-101/300HB/450	7.63 *	4.25 *
CZ-11/193LF/134	6.00	4.00
200/675/470	6.50	4.25
ZP-21/20/200	6.50	4.25
935-152/101-147/827-1	5.25	5.25
304/201/239	9.50	8.50
ZP-500/545/369	8.63	5.50
GANICIN/CORLAR/IMRON	7.75	11.00
519/1447/428	8.00	7.75
5530/5461/6200	5.25	3.25
5536/5461/6200	6.50	4.00
IZ-22/INTERGARD/INTERTHANE	5.25	4.00
701/654/1122BRS	7.00	4.00
13-F-12/13-R-60/40	7.25	4.50
5-Z/516/290	7.75	4.25
311/MCR-43/4610	7.25	4.00
1001/97-3/97-812	7.00	5.33
RZ-100/59ZP/300	7.13 *	4.75 *
5686/M9373/9400	6.75	4.00
B69-V-1/TILE CLAD/POLANE	6.50	4.00
75511543417523	8.25	5.00
GALVANOX IV/8051/3000	4.75	4.00
GALVANOX V/8051/3000	6.13	4.25
90E-75/66/70	7.00	4.25

* - EXPOSED 1/87

TABLE IV

RUST GRADE EVALUATIONS AFTER 60-MONTH SEACOAST EXPOSUREASTM D-610-68174) RUST GRADES*

<u>VHN-HBEU COATING SYSTEM</u>	<u>NORMAL EXPOSURE</u>	<u>ACID TREATED</u>
D-6N/383HS/AMERSHIELD	7.25	4.75
D-9/383HS/AMERSHIELD	6.25	4.25
SP-101/300HB/451	8.25 *	4.00 *
CZ-11/190HB/133HB	6.75	4.50
200/690/470	7.38	4.25
ZP-21/39/200	7.00	4.50
935-152/111-111/827-1	6.13	4.50
304/230/249	9.13	7.88
ZP-500/547/359	7.75	5.00
GANICIN/CORLAR HB/IMRON HB	7.88	4.25
519/1447/449	8.50	6.00
5530/5555/GLIDTHANE HB	6.25	4.00
5536/5555/GLIDTHANE HB	7.00	5.25
IZ-22/INTERGARD HB/INTERTHANE HB	6.25	4.00
701/HIGARD/1122BRS	7.25	5.25
13-F-12/78-D-7/41	7.88	6.00
5-Z/520/295	7.75	6.25
311/MCR 43/8610	8.63	7.50
1001/97-139/97-812	8.83	5.66
RZ-100/70/320	8.38 *	6.25 *
5686/9582 HB/9400	7.88	5.00
B69-V-1/E102/E106	6.00	4.25
75511543417523	8.13	4.75
GALVANOX IV/8500/3100	5.00	4.00
GALVANOX V/8500/3100	5.25	4.50
90E-75/66/73	6.88	5.50

* - EXPOSED 1/87

TABLE V

RUST GRADE EVALUATIONS AFTER 60-MONTE SEACOAST EXPOSUREASTM D-610-68/741 RUST GRADES*

<u>VEN-REC COATING SYSTEM</u>	<u>NORMAL EXPOSURE</u>	<u>ACID TREATED</u>
D-6N/400/AMERSHIELD	7.25	4.25
D-9/400/AMERSHIELD	7.25	4.25
CZ-11/188HB/133HB	6.50	4.50
ZP-21/47/93/98	7.50	4.50
304/201/249	9.25	8.88
GANICIN/CORLAR HB/IMRON	7.00	4.50
IZ-22/TAA 423/INTERPHANE	5.00	5.00
13-F-12/83/22	7.25	5.00
311/MG-77/4610	9.75	9.00
1001/97-148/97-812	8.50	5.33
5686/95-1501/9400	9.00	6.63
GALVANOX IV/4551/3100	5.00	4.13
GALVANOX v/4551/3100	6.63	4.50

TABLE VI

RUST GRADE EVALUATIONS AFTER 60-MONTH SEACOAST EXPOSURE

<u>VEN-IO COATING SYSTEM</u>	<u>NORMAL EXPOSURE</u>	<u>ACID TREATED</u>
D-6N/741	10.00	9.00
D-9/741	10.00	9.00
SP-101/741	10.00 *	8.00 *
CZ-11/741	10.00	6.00
200/741	10.00	8.00
ZP-21/741	10.00	---
935-152/741	9.00	8.00
ZP-500/741	10.00	7.00
GANICIN/741	10.00	8.00
519/741	10.00	9.00
5530/741	10.00	8.00
5536/741	10.00	5.00
IZ-22/741	10.00	7.00
701/741	10.00	7.00
13-F-12/741	10.00	7.00
5-Z/741	10.00	7.00
311/741	10.00	8.00
RZ-100/741	10.00 •	□□□□ □
B69-V-1/741	10.00	10.00
7551/741	10.00	10.00
GALVANOX IV/741	10.00	8.00
GALVANOX V/741	10.00	5.00
90E-75/741	10.00	8.00

* - EXPOSED 1/87

AVERAGE OF ALL PANELS (12-2)	8.48	----
AVERAGE OF ALL PANELS (VEN-EU)	6.79	4.72
AVERAGE OF ALL PANELS (VEN-HBEU)	7.21	5.07
AVERAGE OF ALL PANELS (VEN-REC)	7.3%	5.42
AVERAGE OF ALL PANELS (VEN-IO)	9.96	7.82

91-4821

18



91-4821

19



NO MTB 268-86 RACK NO.: 21C DATE : 5/91

EXPOSURE : TOPCOAT-ACID

A

B

C

D

E

5

: ENGARD
: 519: NAPKO
: 2-z: TNEMEC
: SOE-75: AMERON
: D-6N: AMERON
: D-9: AMERON
: 741: AMERON
: 741: AMERON
: 741: AMERON
: 741: AMERON
: 741

4

: RELIANCE
: RELZINC
: 100
: 70
: 320: :
: :
: :
: :
: :: KOPPERS
: 701
: AMERON
: 741: DEVOE
: ZP 500
: AMERON
: 741: CEILGARD
: 200
: AMERON
: 741

3

: RELIANCE
: RELZINC
: 100
: 59ZP
: 300: RELIANCE
: RELZINC
: 100
: 59ZP
: 300: RELIANCE
: RELZINC
: 100
: 70
: 320: RELIANCE
: RELZINC
: 100
: 70
: 320: RELIANCE
: RELZINC
: 100
: 70
: 320

2

: BYCO
: 101
: 300HB
: 451: BYCO
: 101
: 300HB
: 451: BYCO
: 101
: 300HB
: 451: RELIANCE
: RELZINC
: 100
: 59ZP
: 300: RELIANCE
: RELZINC
: 100
: 59ZP
: 300

1

: BYCO
: 101
: 300HB
: 450: BYCO
: 101
: 300HB
: 451

STUDY NO.: MTB 268-86 RACK NO.: 1A

DATE : 5/91

EXPOSURE: TOPCOAT-NORMAL

A

B

C

D

E

5 : DEVOE-
: NAPKO
: 22
: 547
: 359

: DEVOE-
: NAPKO
: 2Z
: 547
: 359

4 : (REC)
: SUBOX
: GALV 4
: 4551
: 3100

: DEVOE-
: NAPKO
: 2Z
: 545
: 369

: DEVOE-
: NAPKO
: 2Z
: 545
: 369

: DEVOE-
: NAPKO
: 2Z
: 545
: 369

: DEVOE-
: NAPKO
: 2Z
: 547
: 359

3 : SUBOX
: GALV 4
: 8500
: 3100

: SUBOX
: GALV 4
: 8500
: 3100

: (REC)
: SUBOX
: GALV 4
: 4551
: 3100

: (REC)
: SUBOX
: GALV 4
: 4551
: 3100

: (REC)
: SUBOX
: GALV 4
: 4531
: 3100

2 : SUBOX
: GALV 4
: 8051
: 3000

: SUBOX
: GALV 4
: 8051
: 3000

: SUBOX
: GALV 4
: 8051
: 3000

: SUBOS
: GALV 4
: 8500
: 3100

: SUBOX
: GALV 4
: 8500
: 3100

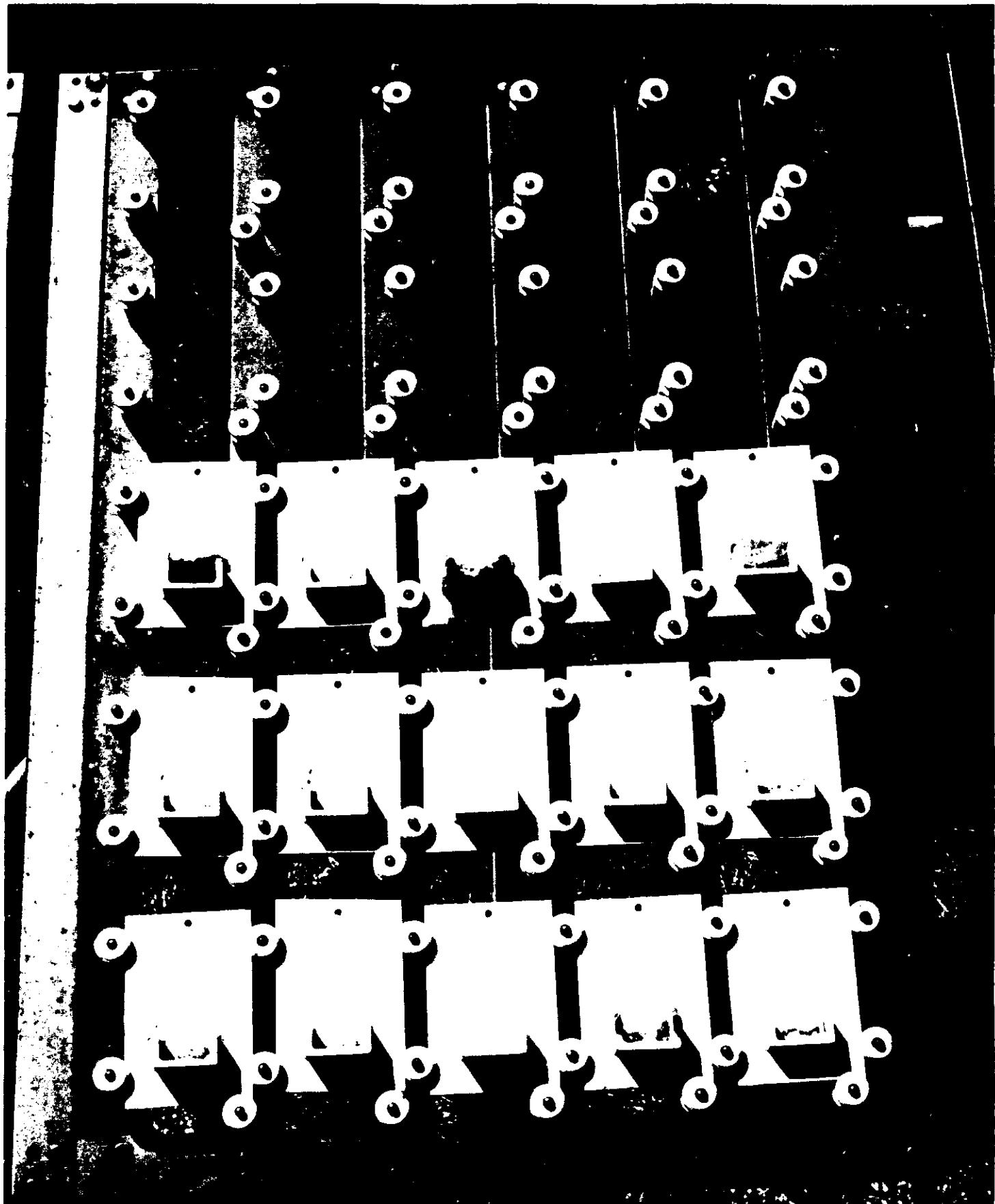
1 : ENGARD
: 519
: 1447
: 428

: ENGARD
: 519
: 1447
: 420

: ENGARD
: 519
: 1447
: 428

: ENGARD
: 519
: 1447
: 428

: SUBOS
: GALV 4
: 8051
: 3000



STUDY NO.: MTB 268-86 RACK NO.: 1%

DATE : 5/91

EXPOSURE: TOPCOAT-XCID

A

B

C

D

E

5

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4

--	--	--	--	--

3

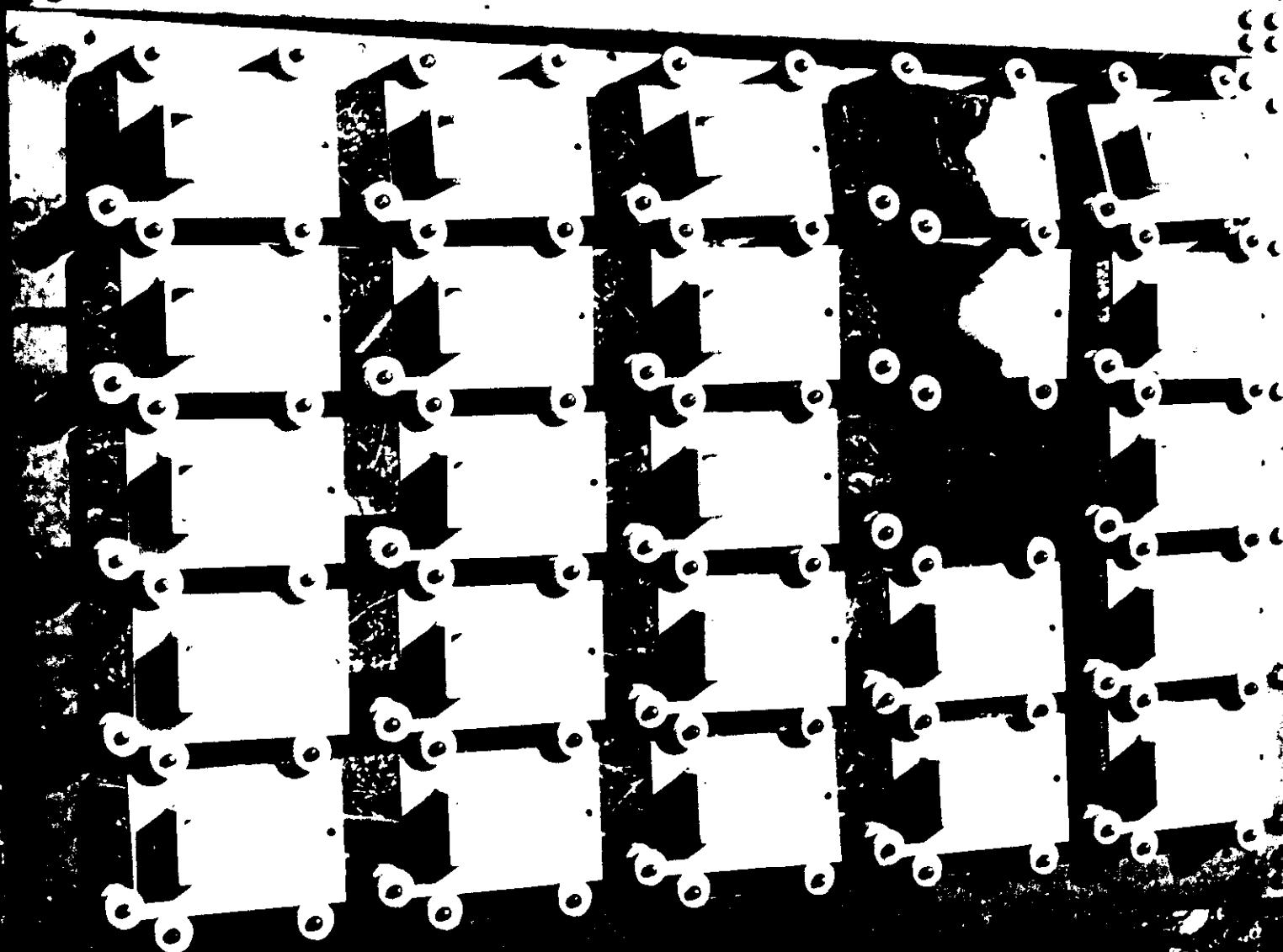
: SUBOX : IV : AMERON 741	: DUPONT : GANICIN : AMERON 741	: GLIDZINC 5536 : AMERON 741	: RELIANCE 100 : AMERON 741	: NAPKO 5-z : AMERON 741
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2

: PORTER 311 : AMERON 741	: BYCO 101 : AMERON 741	: SHERWIN- WILLIAMS : ZINCLAD : AMERON 741	: GLIDZINC 5530 : AMERON 741	: MOBIL 7 : AMERON 741
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1

: INTER ZINC : AMERON 741	: CORONADO : 935-152 : AMERON 741	: SIGMA 7551 : AMERON 741	: SUBOX V : AMERON 741	: CARBO ZINC 11 : AMERON 741
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STUDY NO.: MTB 268-86 RACK NO.: 1C

DATE : 5/91

EXPOSURE: ZINC - NORMAL

A

B

C

D

E

5

GLIDDEN;
5530GLIDDEN;
5530GLIDDEN;
5530GLIDDEN;
5530MOBIL
ZINC
7

4

GLIDDEN;
5536GLIDDEN;
5536GLIDDEN;
5536GLIDDEN;
5536MOBIL
ZINC
7

3

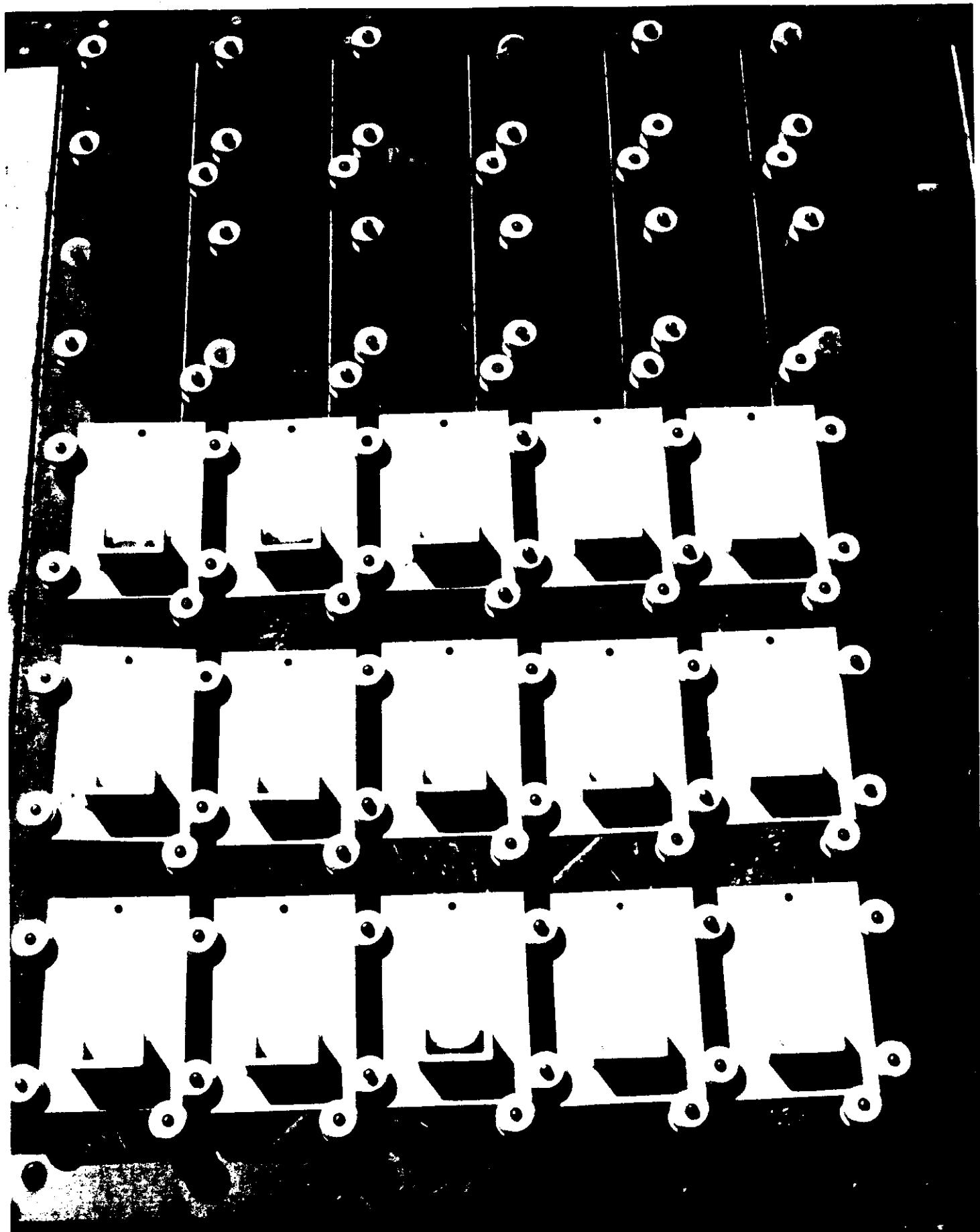
PPG
1001PPG
1001PPG
1001PPG
1001MOBIL
ZINC
7

2

CONLUX
21CONLUX
21CONLUX
21CONLUX
21MOBIL
ZINC
7

1

NAPKO
5ZNAPKO
5ZNAPKO
5ZNAPKO
5ZMOBIL
ZINC
7



STUDY NC.: MTB 268-86 RACK NO.: 2A

DATE : 5/91

EXPOSURE: TOPCOAT-NORMAL

A

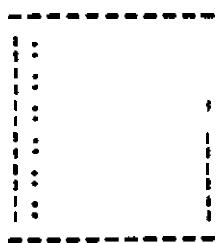
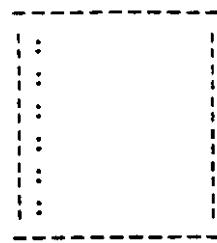
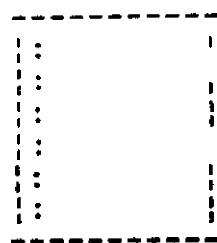
B

C

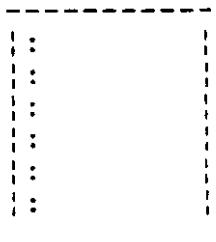
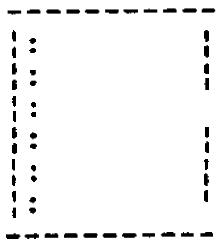
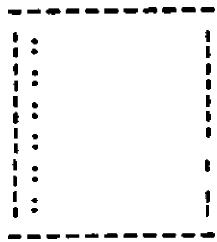
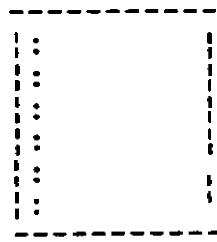
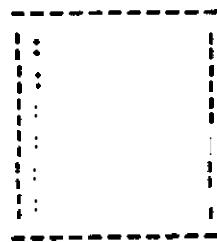
D

E

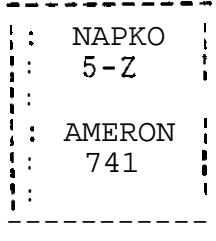
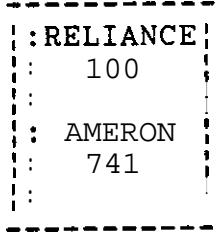
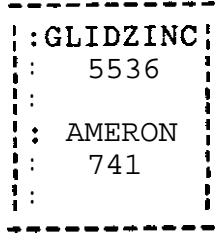
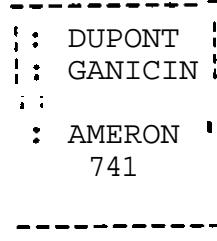
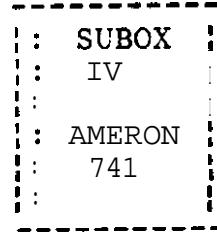
5



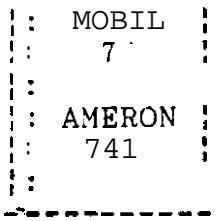
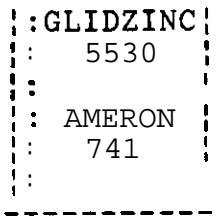
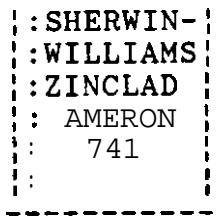
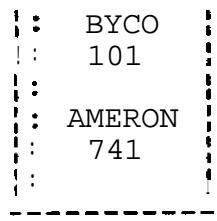
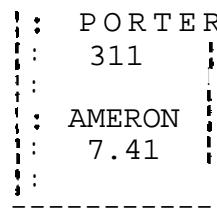
4



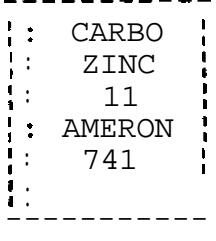
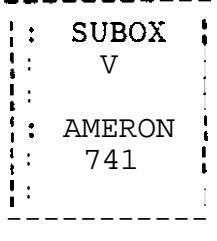
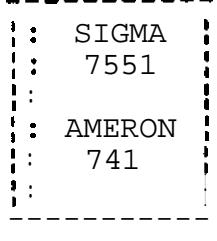
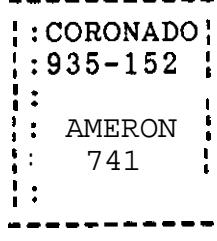
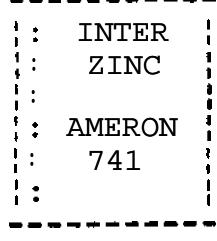
3

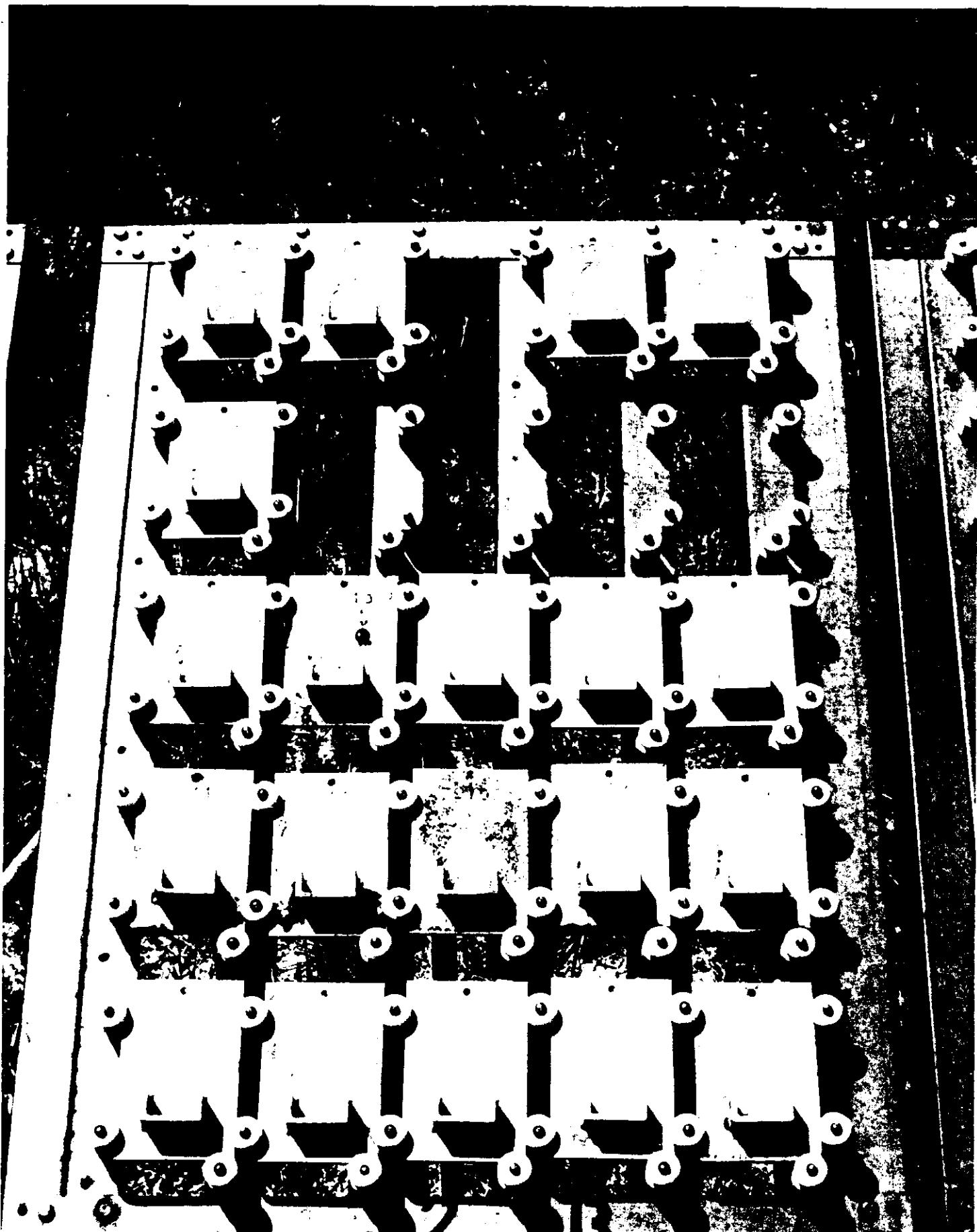


2



1





STUDY NO.: MTB 268-86 RACK NO.: 2%

DATE : 5/91

EXPOSURE: ZINC - NORMAL

A

B

C

D

E

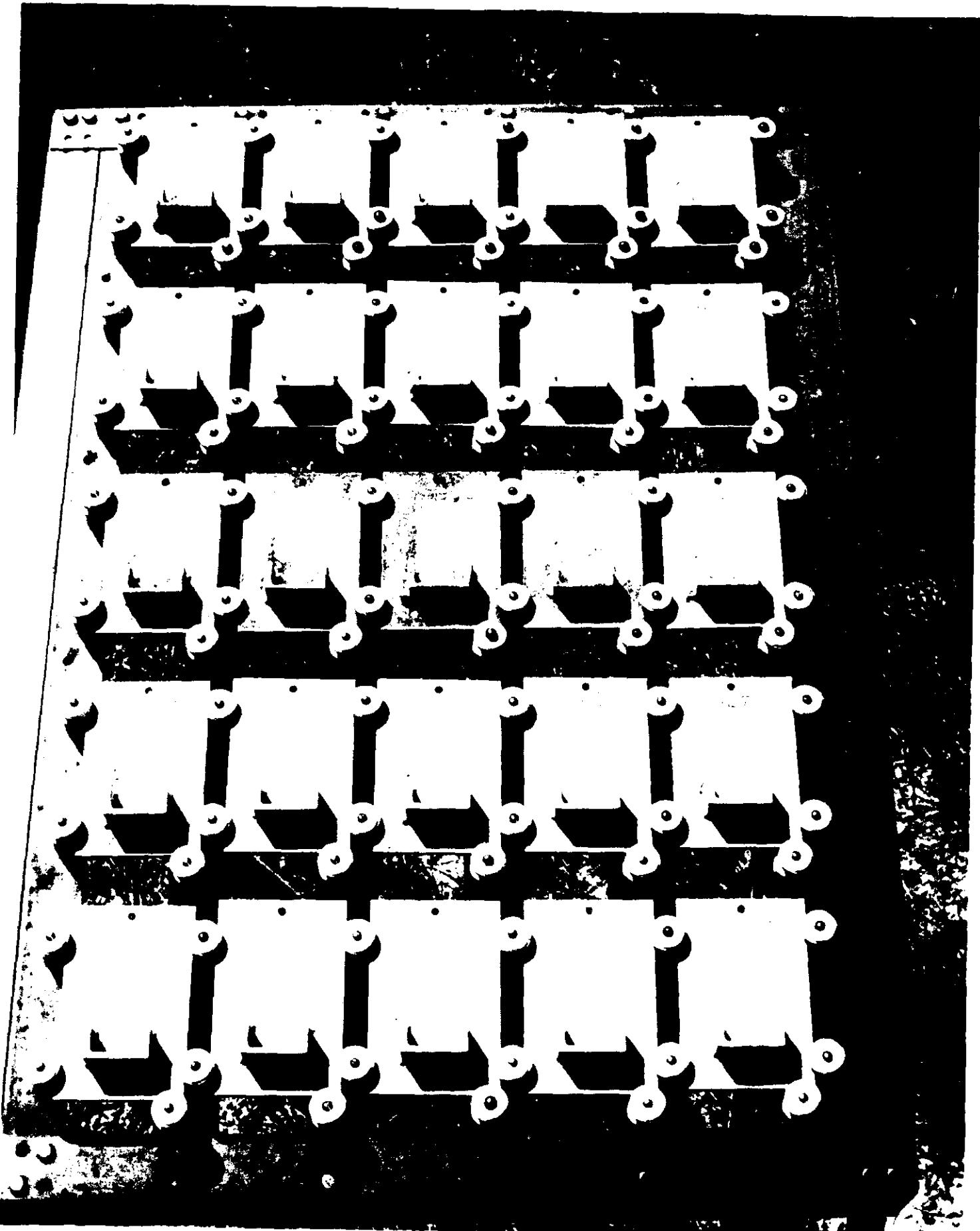
5	: AMERON D-6 5/89	: AMERON D-6 5/89		: AMERON D-6 5/89	: AMERON D-6 5/89
---	-------------------------	-------------------------	--	-------------------------	-------------------------

4	: BYCO 101 4/87				
---	-----------------------	--	--	--	--

3	: PUR-ZINC ME III 1/87	: PUR-ZINC: ME III 1/87	: BYCO 101 4/87	: BYCO 101 4/87	: BYCO 101 4/87
---	------------------------------	-------------------------------	-----------------------	-----------------------	-----------------------

2	: NAPKO 2Z	: NAPKO 2Z	: NAPKO 2Z	: PUR-ZINC ME III 1/87	: PUR-ZINC ME III 1/87
---	---------------	---------------	---------------	------------------------------	------------------------------

1	: ENGARD 519	: ENGARD 519	: ENGARD 519	: ENGARD 519	: NAPKO 2Z
---	-----------------	-----------------	-----------------	-----------------	---------------



STUDY NO. : MTB 268-86 RACK NO.: 2C

DATE : 5/91

EXPOSURE: ZINC - NORMAL

A

B

C

D

E

5 : TNEME-
: ZINC
: 90E-
: 75

: DEVOE
: CATHA-
: COAT
: 304

4 : INTER
: ZINC

: INTER
: ZINC

: INTER
: ZINC

: INTER
: ZINC

: DEVOE
: CATHA-
: COAT
: 304

3 : GARBO-
: ZINC
: 11

: CARBO-
: ZINC
: 11

: CARBO-
: ZINC
: 11

: CARBO-
: ZINC
: 11

: DEVOE
: CATHA-
: COAT
: 304

2 : CEIL-
: GARD
: ZINC
: 200

: DEVOE
: CATHA-
: COAT
: 304

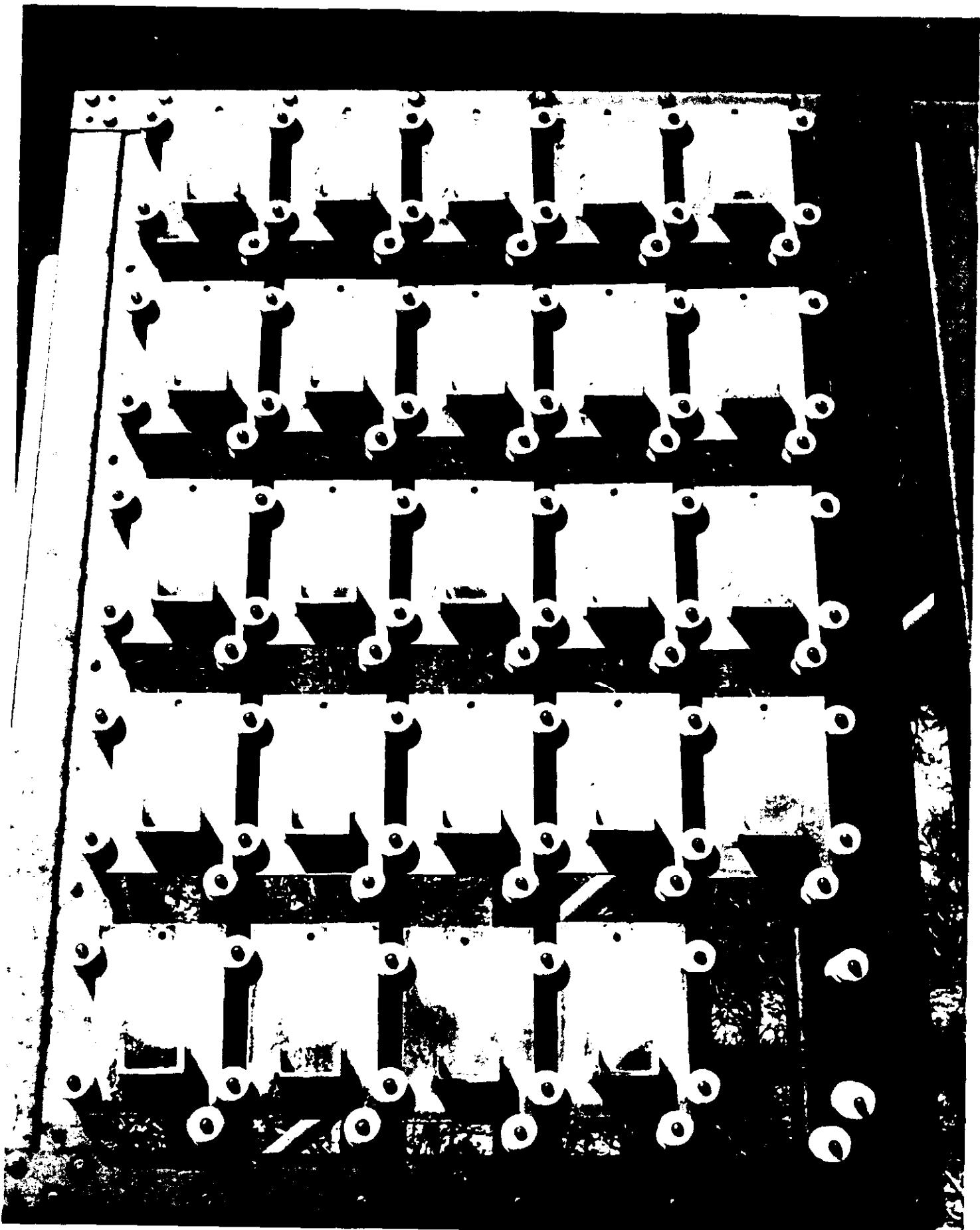
1 SHERWIN-
: WILLIAMS;
: ZINC
: CLAD

: SHERWIN-
: WILLIAMS
: ZINC
: CLAD

: SHERWIN-
: WILLIAMS
: ZINC
: CLAD

: SHERWIN-
: WILLIAMS
: ZINC
: CLAD

: DEVOE
: CATHA-
: COAT
: 304



STUDY NO : MTB 268-86 RACK NO.: 3B

DATE : 5/91

EXPOSURE: ZINC - NORMAL

A

B

C

D

E

5

: SIGMA
: 7551: SIGMA
: 7551: SIGMA
: 7551: SIGMA
: 7551: :
: :
: :

4

: PORTER
: ZINC.
: LOCK
: 311: PORTER
: ZINC
: LOCK
: 311: PORTER
: ZINC
: LOCK
: 311: PORTER
: ZINC
: LOCK
: 311: KOPPERS:
: 701

3

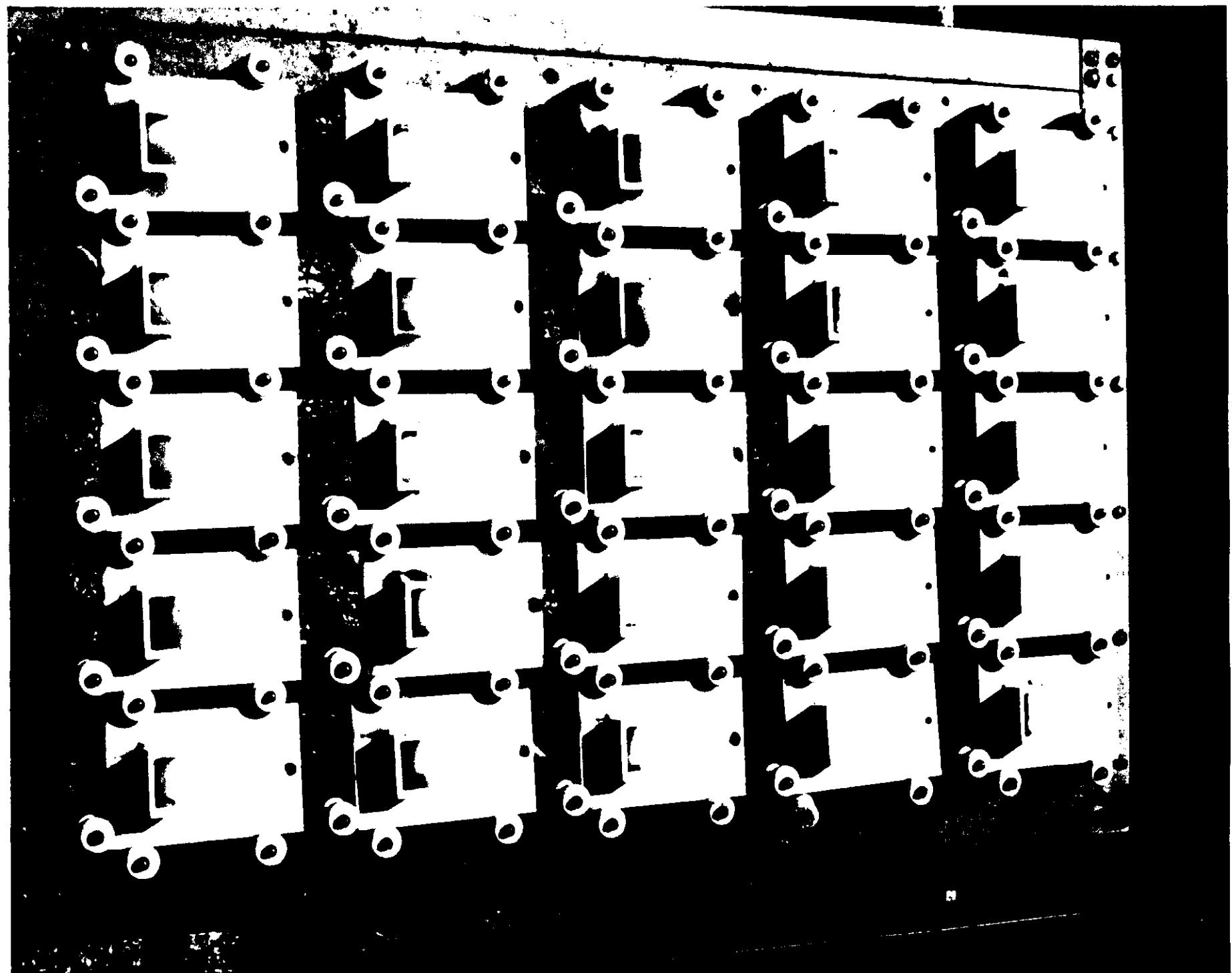
: DUPONT
: GANICIN:
: 347-Y-
: 931: KOPPERS:
: 701

2

: CORONADO
: 935-
: 152: KOPPERS:
: 701

1

: RELIANCE
: REL
: ZINC
: 100: KOPPERS:
: 701



STUDY'NO.: MTB 268-86 RACK NO.: 4A

DATE : 5/91

EXPOSURE: TOPCOAT-NORMAL

A

B

C

D

E

5

: ENGARD
519
: AMERON
741

: NAPKO
2-z
: AMERON
741

: TNEMEC
90E-75
: AMERON
741

: AMERON
D-6N
: AMERON
741

: AMERON
D-9
: AMERON
741

4

: RELIANCE
: RELZINC
100
70
320

: CONLUX
21
: AMERON
741

: KOPPERS
701
: AMERON
741

: DEVOE
ZP 500
: AMERON
741

: CEILGARD
200
: AMERON
741

3

: RELIANCE
: RELZINC
100
59ZP
300

: RELIANCE
: RELZINC
100
59ZP
300

: RELIANCE
: RELZINC
100
70
320

: RELIANCE
: RELZINC
100
70
320

: RELIANCE
: RELZINC
100
70
320

2

: BYCO
101
300HB
451

: BYCO
101
300HB
451

: BYCO
101
300HB
451

: RELIANCE
: RELZINC
100
59ZP
300

: RELIANCE
: RELZINC
100
59ZP
300

1

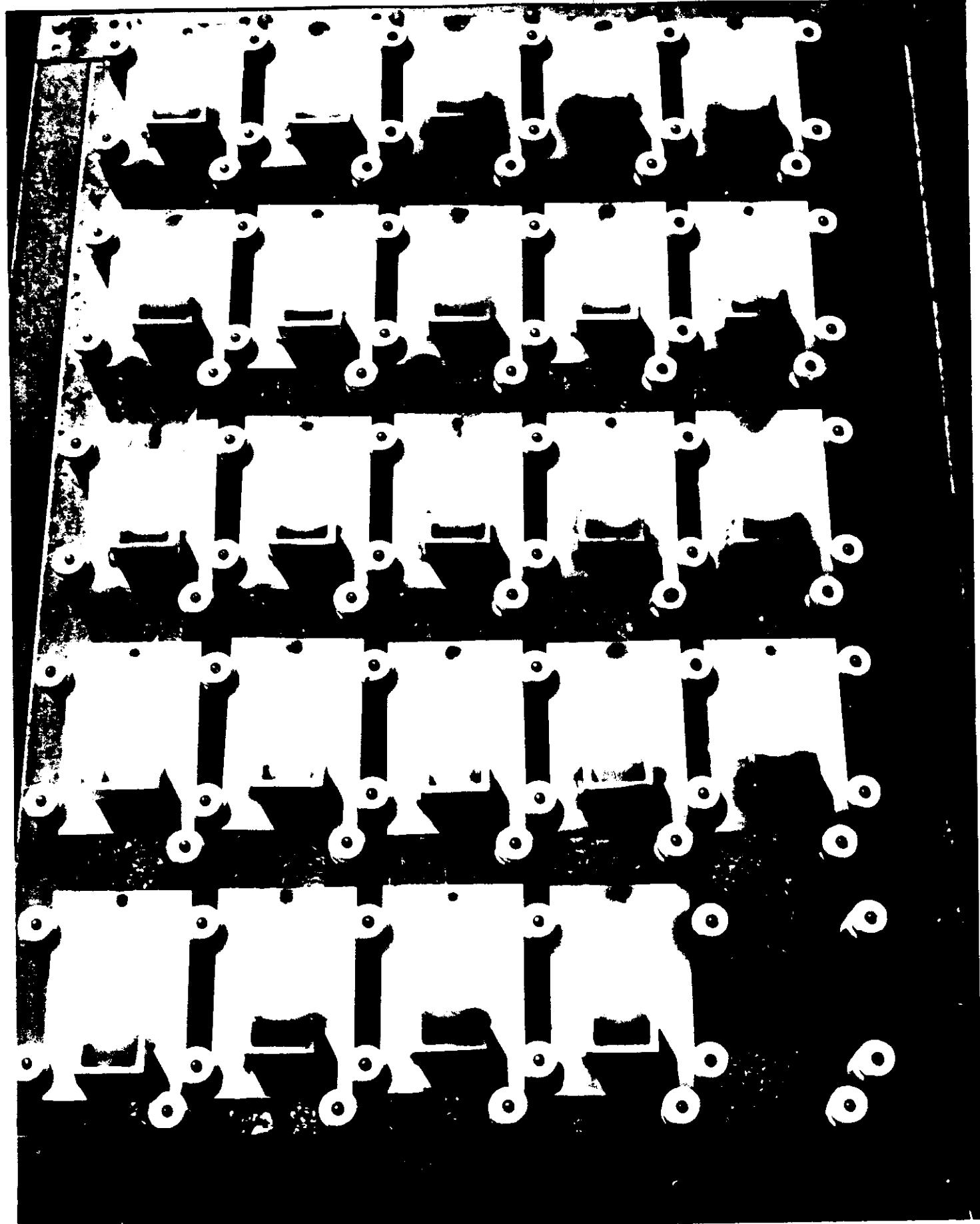
: BYCO
101
300HB
450

: BYCO
101
300HB
450

: BYCO
101
300HB
450

: BYCO
101
300HB
450

: BYCO
101
300HB
451



STUDY NO.: MTB 268-86 RACK NO.: 4B

DATE : 5/9

EXPOSURE: TOPCOAT-NORMAL

A

B

C

D

E

5 GLIDDEN:
5536
5461 I-
6252

GLIDDEN:
5536
5461
6252

GLIDDEN:
5536
5461
6252

GLIDDEN:
5536
5461
6252

GLIDDEN:
5530
5461
6252

4 CONLUX
21
E-39
A-200

CONLUX
21
E-39
A-200

CONLUX
21
E-39
A-200

CONLUX
21
E-39
A-200

GLIDDEN:
5530
5461
6252

3 CONLUX
21
E-20
A-200

CONLUX
21
E-20
A-200

CONLUX
21
E-20
A-200

CONLUX
21
E-20
A-200

GLIDDEN:
5530
5461
6252

2 NAPKO
5Z
520
295

NAPKO
5Z
520
295

NAPKO
5Z
520
295

NAPKO
5Z
520
295

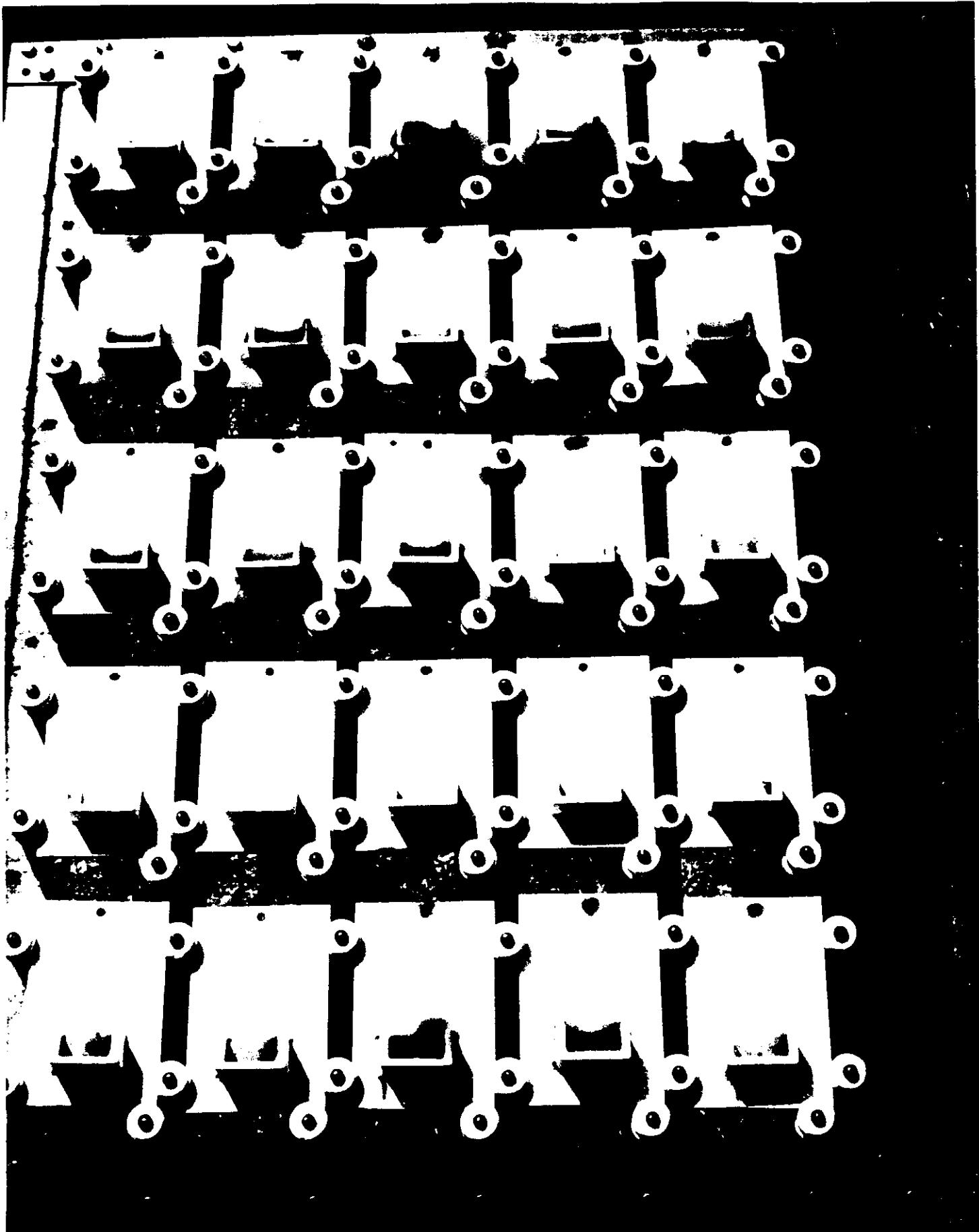
GLIDDEN:
5530
5461
6252

1 NAPKO
5Z
516
290

NAPKO
5Z
516
290

NAPKO
5Z
516
290

NAPKO
5Z
516
290



STUDY NO.: MTB 268-86 RACK NO.: 4C

DATE : 5/91

EXPOSURE: TOPCOAT-NORMAL

A

B

C

D

E

5 : CEILCOTE
 : 200
 : EP675
 : 470-01

: CEILCOTE
 : 200
 : EP690
 : 470-01

4 : GLIDDEN
 : 5530
 : 5555
 : HBU

: GLIDDEN:
 : 5530
 : 5555
 : HBU

: GLIDDEN:
 : 5530
 : 5555
 : HBU

: GLIDDEN:
 : 5530
 : 5555
 : HBU

: CEILCOTE
 : 200
 : EP690
 : 470-01

3 : (REC)
 : PPG
 : 1001
 : 97-148
 : 97-812

: GLIDDEN
 : 5536
 : 5555
 : HBU

: GLIDDEN:
 : 5536
 : 5555
 : HBU

: GLIDDEN
 : 5536
 : 5555
 : HBU

: GLIDDEN:
 : 5536
 : 5555
 : HBU

2 : PPG
 : 1001
 : 97-130
 : 97-812

: PPG
 : 1001
 : 97-130
 : 97-812

: PPG
 : 1001
 : 97-130
 : 97-812

: (REC)
 : PPG
 : 1001
 : 97-148
 : 97-812

: (REC)
 : PPG
 : 1001
 : 97-148
 : 97-812

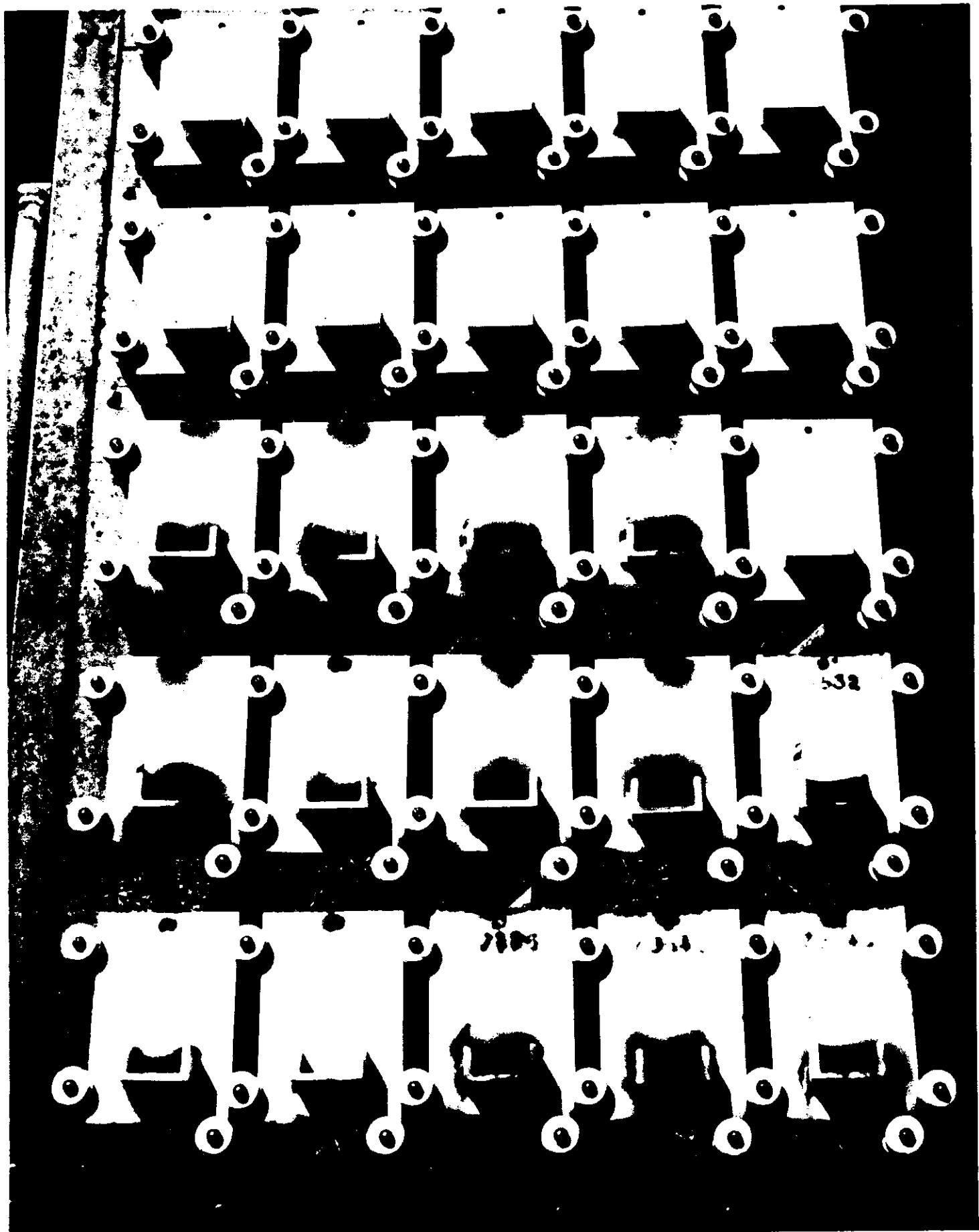
1 : PPG
 : 1001
 : 97-3
 : 97-812

: PPG
 : 1001
 : 97-3
 : 97-812

: PPG
 : 1001
 : 97-3
 : 97-812

: (REC)
 : CONLKJX
 : 21
 : w-47
 : v-93
 : V-98

: (REC)
 : CONLUX
 : 21
 : w-47
 : v-93
 : V-98



STUDY NO.: MTB 268-86 RACK NO.: 5A

DATE : 5/91

EXPOSURE: TOPCOAT-NORMAL

A

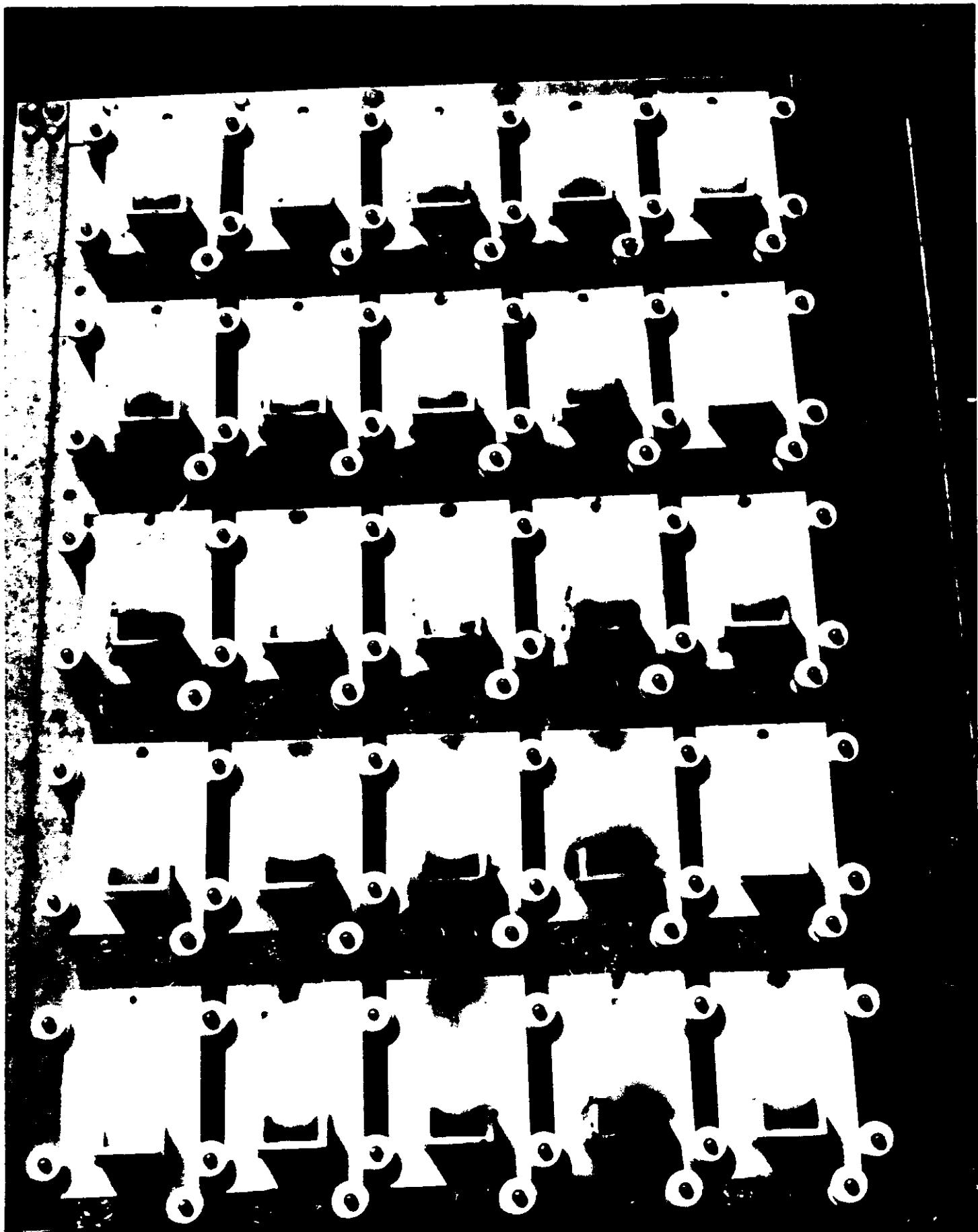
B

C

D

E

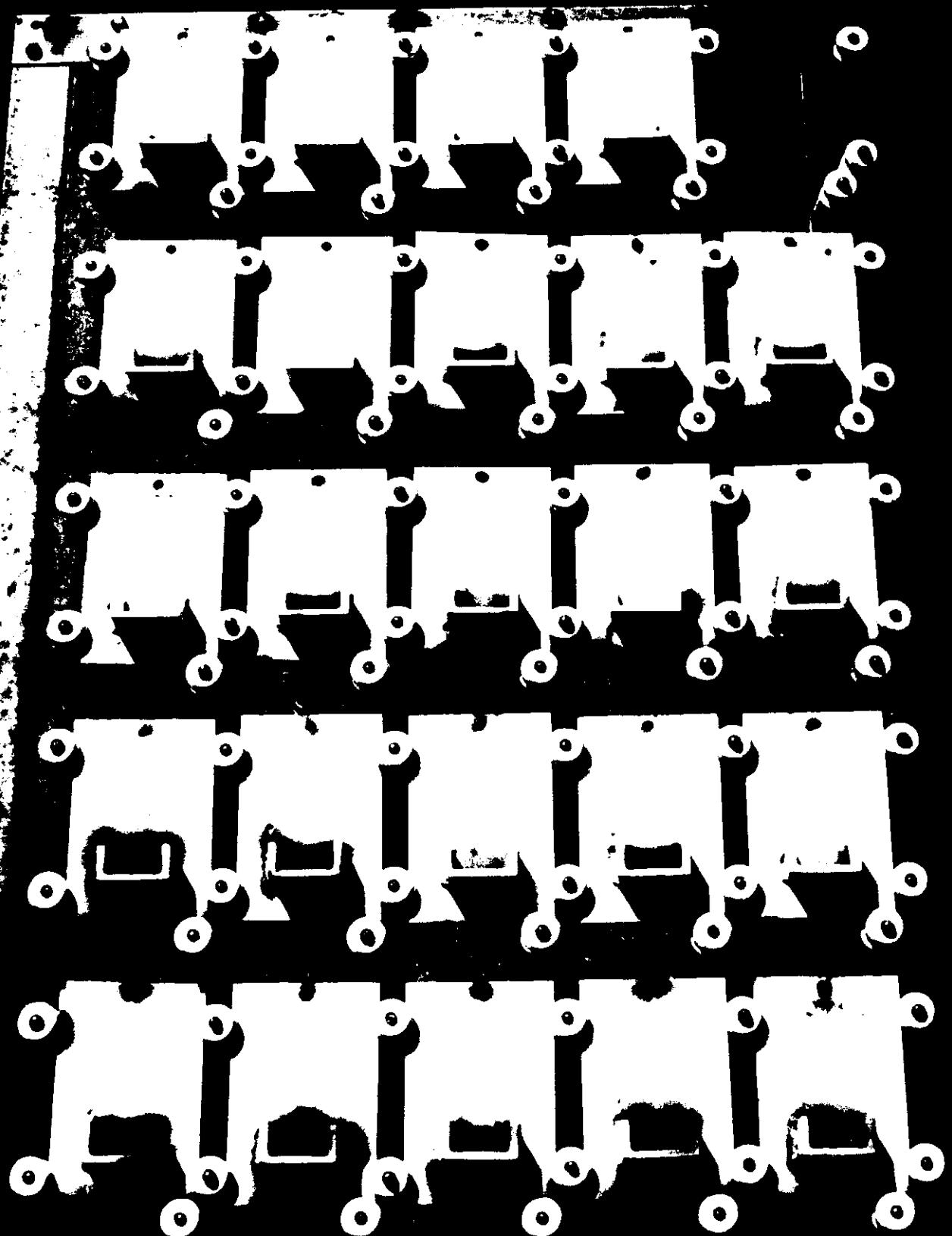
5	: DEVOE-	: DEVOE-	: DEVOE-	: DEVOE-	: (REC)
	: MARINE	: MARINE	: MARINE	: MARINE	: DEVOE-
	304	304	304	304	: MARINE
	230	230	230	230	304
	249	249	249	249	201
4	: DEVOE-	: DEVOE-	: DEVOE-	: DEVOE-	: (REC)
	: MARINE	: MARINE	: MARINE	: MARINE	: DEVOE-
	304	304	304	304	: MARINE
	201	201	201	201	304
	239	239	239	239	201
3	: (REC)	: (REC)	: (REC)	: (REC)	: (REC)
	: CARBO	: CARBO	: CARBO	: CARBO	: DEVOE-
	cz-11	cz-11	cz-11	cz-11	: MARINE
	188HB	188HB	188HB	188HB	304
	134	134	134	134 I	201
2	: CXRBO	: CARBO	: CARBO	: CARBO	: CARBO
	CZ-11	cz-11	cz-11	cz-11	cz-11
	190HB	190HB	190HB	190HB	193LF
	133HB	133HB	133HB	133HB	134
1	: CEILCOTE	: CEILCOTE	: CARBO	: CARBO	: CARBO
	200	200	cz-11	cz-11	CZ-11
	EP690	EP690	193LF	193LF	193LF
	470-01	470-01	134	134	134



STUDY NO.: MTB 268-86 RACK NO.: 5B DATE : 5/91

EXPOSURE: TOPCOAT-NORMAL

	A	B	C	D	E
5	: MOBIL : ZINC 7 : 13-R-60: : 40	: MOBIL : ZINC 7 : 13-R-60: : 40	: MOBIL : ZINC 7 : 13-R-601 : 40	: MOBIL : ZINC 7 : 13-R-60: : 40	: MOBIL : ZINC 7 : 78 : 41
4	: SHERWIN : WILLIAMS : ZINCLAD : HI SOLID; : HI BILD	: SHERWIN : WILLIAMS : ZINCLAD : HI SOLID; : HI BILD	: SHERWIN : WILLIAMS : ZINCLAD : HI SOLID : HI BILD	: SHERWIN : WILLIAMS : ZINCLAD : HI SOLID; : HI BILD	MOBIL ZINC 7 78 41
3	: SHERWIN : WILLIAMS : ZINCLAD : TILECLAD : POLANE	: SHERWIN : WILLIAMS : ZINCLAD : TILECLAD : POLANE	: SHERWIN : WILLIAMS : ZINCLAD : TILECLAD : POLANE	: SHERWIN : WILLIAMS : ZINCLAD : TILECLAD : POLANE	: MOBIL : ZINC 7 : 78 : 41
2	: TNEMEC : 90-E-75 : 66(H) : 73	: TNEMEC : 90E-75 : 66(H) : 73	: TNEMEC : 90E-75 : 66(H) : 73	: TNEMEC : 90E-75 : 66(H) : 73	: MOBIL : ZINC 7 : 78 : 41
1	: (REC) : DEVOE- : MARINE : 304 : 201 : 249	: TNEMEC : 90E-75 : 66(L) : 70	: TNEMEC : 90E-75 : 66(L) : 70	: TNEMEC : 90E-75 : 66(L) : 70	: TNEMEC : 90E-75 : 66(L) : 70



STUDY NO.: MTB 268-86 RACK NO.: 5C

DATE : 5/91

EXPOSURE: TOPCOAT-NORMAL

A

B

C

3

5 : (REC)
 : AMERON
 : D-6N
 : 400
 : 2490

: (REC)
 : AMERON
 : D-6N
 : 400
 : 2490

: (REC)
 : AMERON
 : D-6N
 : 400
 : 2490

: (REC)
 : AMERON
 : D-6N
 : 400
 : 2490

4 : AMERON
 : D-6N.
 : 182
 : 450GL

: AMERON
 : D-6N
 : 383HS
 : 2490

: AMERON
 : D-6N
 : 383HS
 : 2490

: AMERON
 : D-6N
 : 383HS
 : 2490

: AMERON
 : D-6N
 : 3 e 3 Hs
 : 2490

3 : (REC)
 : AMERON
 : D-9
 : 400
 : 2490

: (REC)
 : AMERON
 : D-9
 : 400
 : 2490

: AMERON
 : D-6N
 : 182
 : 450GL

: AMERON
 : D-6N
 : 182
 : 450GL

: AMERON
 : D-6N
 : 182
 : 450GL

2 : AMERON
 : D-9
 : 383HS
 : 2490

: AMERON
 : D-9
 : 383HS
 : 2490

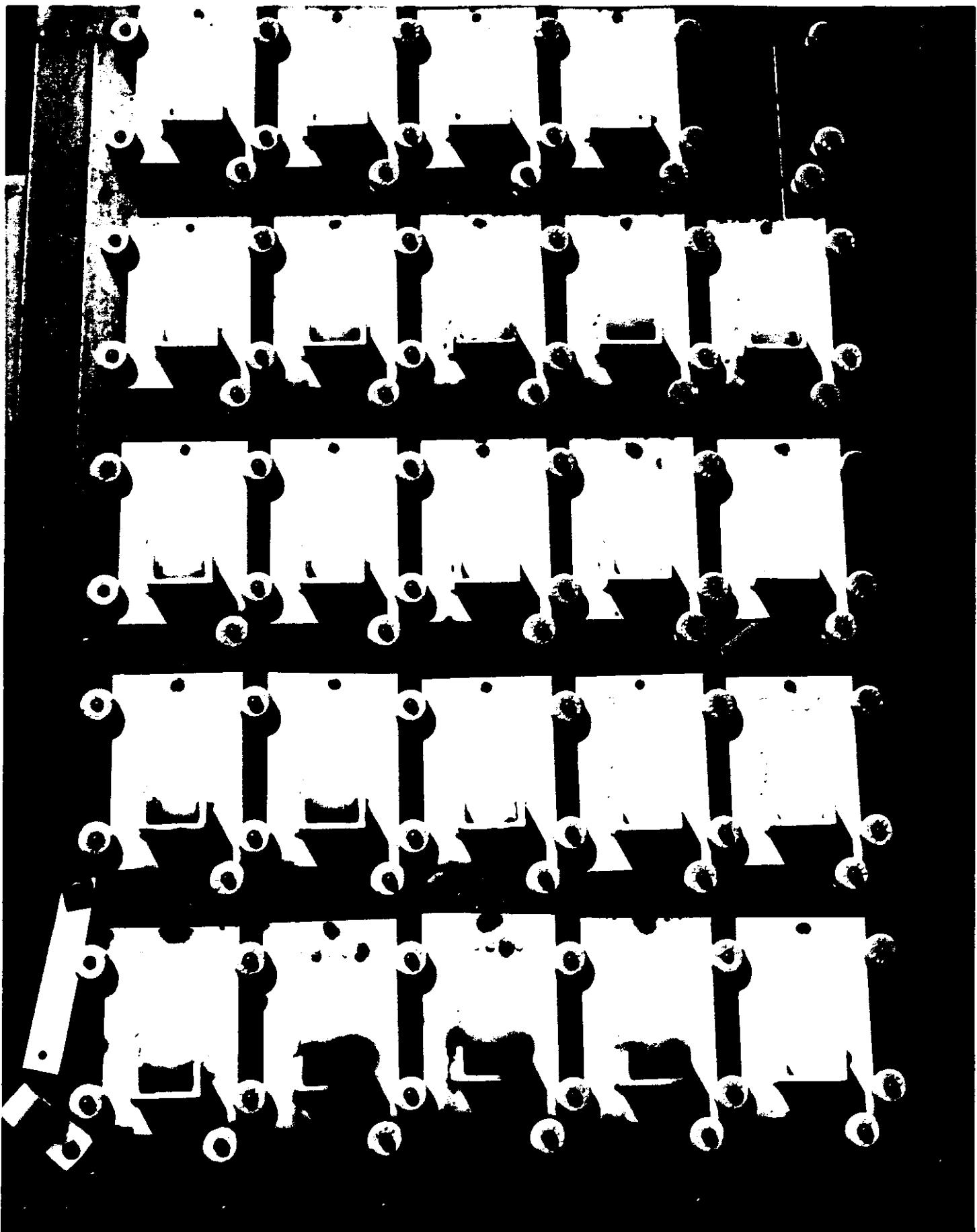
: AMERON
 : D-9
 : 383HS
 : 2490

: (REC)
 : AMERON
 : D-9
 : 400
 : 2490

: (REC)
 : AMERON
 : D-9
 : 400
 : 2490

1 : AMERON
 : D-9
 : 182
 : 450GL

: AMERON
 : D-9
 : 383HS
 : 2490



STUDY NO.: MTB 268-86 RACK NO.: 7A

DATE : 5/91

ESPOSURE:: TOPCOAT-NORMAL

A

B

C

D

E

:	ENGARD
5	519
:	1447(L)
	449

:	ENGARD
	519
	1447(L)
	449

:	ENGARD
	519
	1447(L)
	449

:	ENGARD
	519
	1447(L)
	449

:	

:	DEVOE-
4	:PRUFCOAT
:	Z.P.500
	545
	369

:	DEVOE-
	:PRUFCOAT
	Z.P.500
	547
	359

:	DEVOE-
	:PRUFCOAT
	Z.P.500
	547
	359

:	DEVOE-
	:PRUFCOAT
	Z.P.500
	547
	359

:	DEVOE-
	:PRUFCOAT
	Z.P.500
	547
	359

:	(REC)
	RUST-
	OLEUM
	5686
	95-1501
	9400

:	(REC)
	RUST-
	OLEUM
	5686
	95-1501
	9400

:	DEVOE-
	:PRUFCOAT
	Z.P.500
	545
	369

:	DEVOE-
	:PRUFCOAT
	Z.P.500
	545
	369

:	DEVOE-
	:PRUFCOAT
	Z.P.500
	545
	369

:	RUST-
	OLEUM
	5686
	9582
	9400

:	RUST-
	OLEUM
	5686
	9582
	9400

:	RUST-
	OLEUM
	5686
	9582
	9400

:	(REC)
	RUST-
	OLEUM
	5686
	95-1501
	9400

:	(REC)
	RUST-
	OLEUM
	5636
	95-1501
	9400

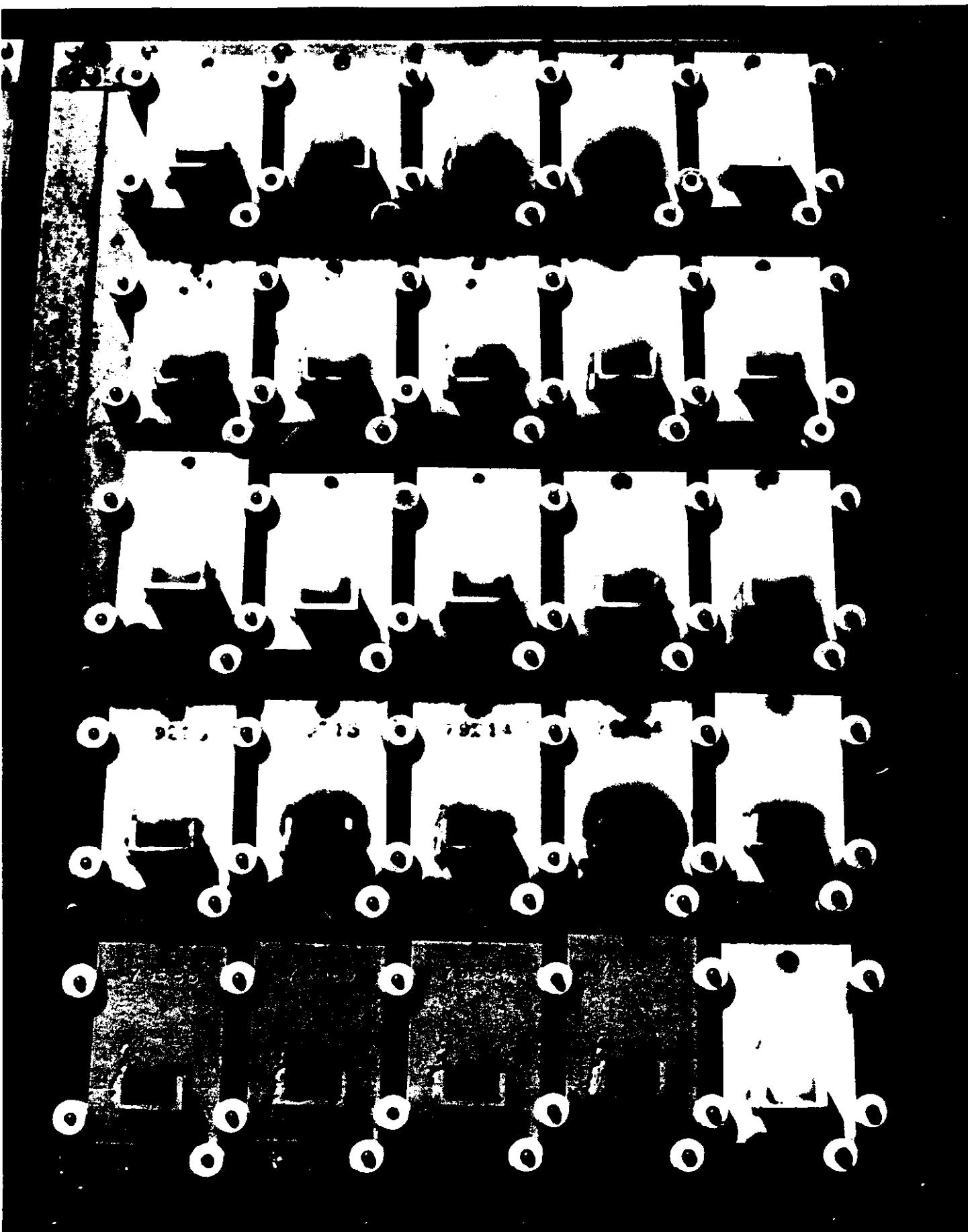
:	RUST-
	OLEUM
	5686
	9373
	9400

:	RUST-
	OLEUM
	5686
	9373
	9400

:	RUST-
	OLEUM
	5686
	9373
	9400

:	RUST-
	OLEUM
	5686
	9373
	9400

:	RUST-
	OLEUM
	5686
	9582
	9400



STUDY NO.: MTB 268-86 RACK NO.: 7B

DATE : 5/91

EXPOSURE: TOPCOAT-NORMAL

A

B

C

D

E

5 : CORONADO
 : 935-152
 : 101-147
 I: 827-1
 :

: CORONADO
 : 935-152
 : 101-147
 I: 827-1
 :

: CORONADO
 : 935-152
 : 101-147
 I: 827-1
 :

: CORONADO
 : 935-152
 : 101-147
 I: 827-1
 :

: CORONADO
 : 935-152
 : 111-111
 I: 827-1
 :

4 : (REC)
 : INTER-
 : ZINC
 : TAA423
 : PHBOOO
 :

: (REC)
 : INTER-
 : ZINC
 : TAA423
 : PHBOOO
 :

: (REC)
 : INTER-
 : ZINC
 : TAA423
 : PHBOOO
 :

: (REC)
 : INTER-
 : ZINC
 : TAA423
 : PHBOOO
 :

: CORONADO
 : 935-152
 : 111-111
 I: 827-1
 :

3 : INTER-
 : ZINC
 : EXA008
 : PHBOOO
 :

: INTER-
 : ZINC
 : EXA008
 : PHBOOO
 :

: INTER-
 : ZINC
 : EXA008
 : PHBOOO
 :

: INTER-
 : ZINC
 : EXA008
 : PHBOOO
 :

: CORONADO
 : 935-152
 : 111-1111
 I: 827-1
 :

: INTER-
 : ZINC
 745
 : PCB000
 :

: CORONADO
 : 935-152
 : 111-1111
 I: 827-1
 :

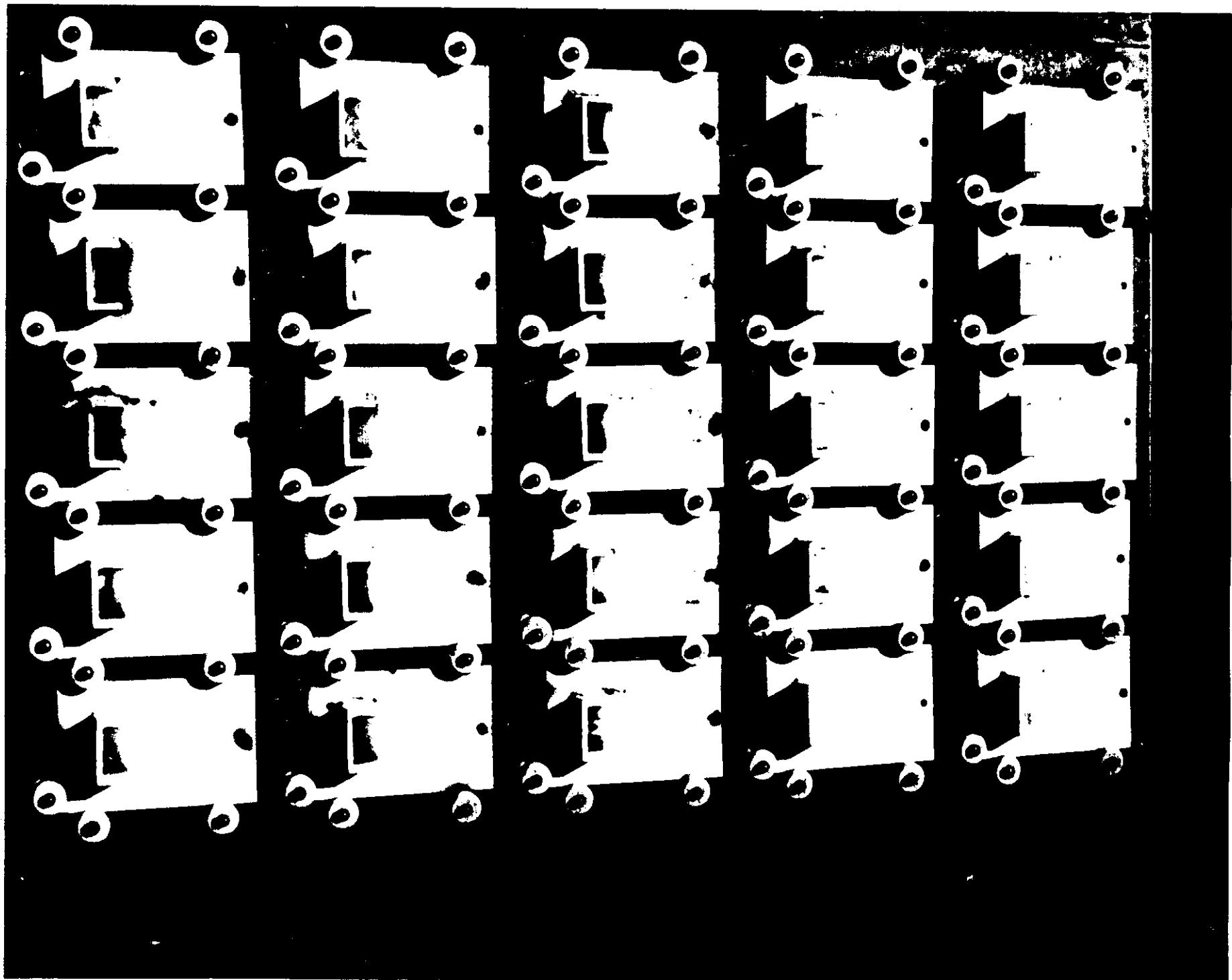
1 : (REC)
 : MOBIL
 : ZINC 7
 : 83
 : 22
 :

: (REC)
 : MOBIL
 : ZINC 7
 : 83
 : 22
 :

: (REC)
 : MOBIL
 : ZINC 7
 : 83
 : 22
 :

: (REC)
 : MOBIL
 : ZINC 7
 : 83
 : 22
 :

: DUPONT
 : 931
 : 823BB
 : 326BB
 :



STUDY NO.: MTB 268-86 RACK NO.: 7C

DATE : 5/91

EXPOSURE: TOPCOAT-NORMAL

A

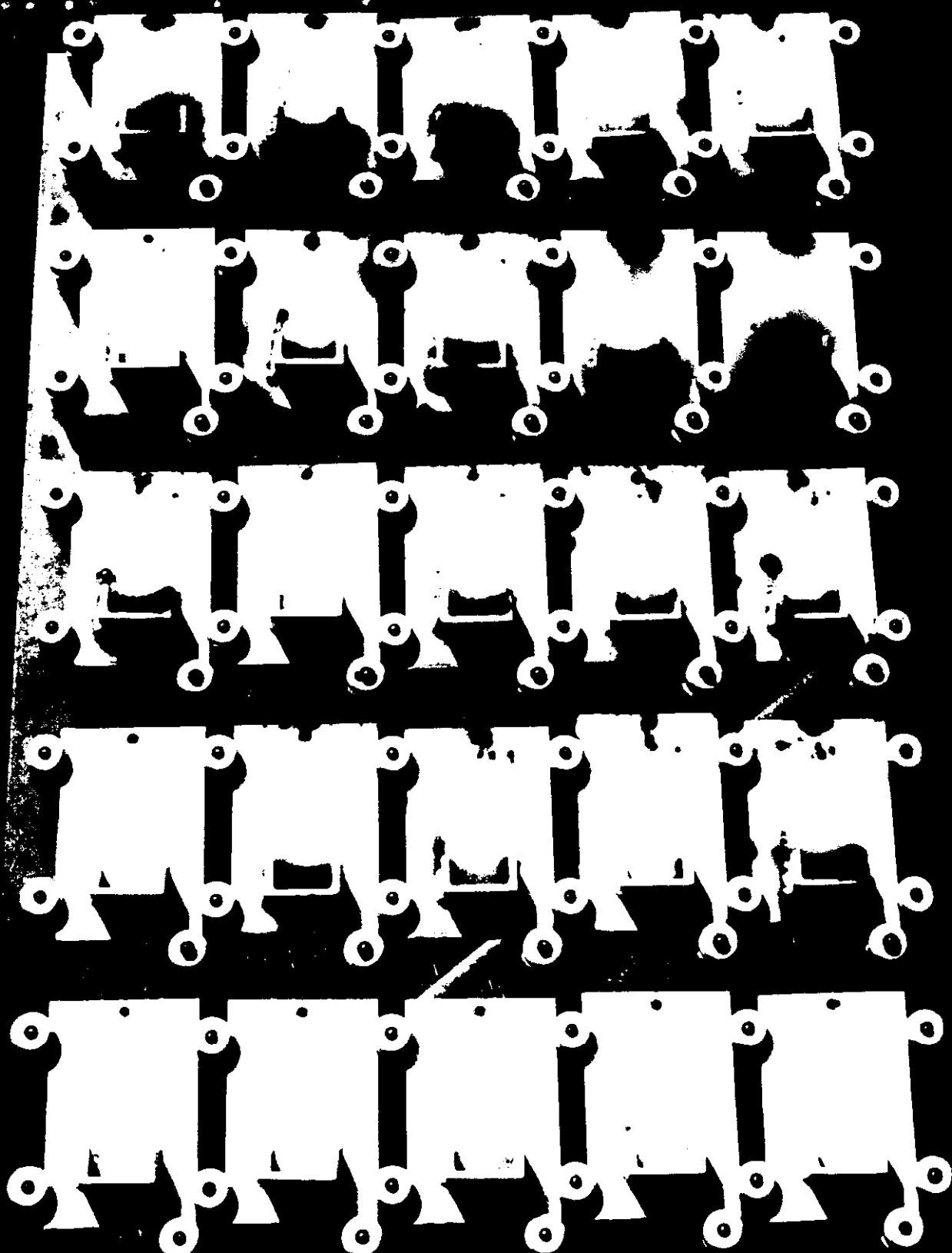
B

C

D

E

5	(REC)	(REC)	(REC)	SIGMA	SIGMA
	PORTER	PORTER	PORTER	7551	7551
	311	311	311	5434(L)	5434(L)
	MAGNA-	MAGNA-	MAGNA-	7523	7523
	GLASS 77	GLASS 77	GLASS 77		
4	4610	4610	4610		
	PORTER	PORTER	PORTER	PORTER	(REC)
	311	311	311	311	PORTER
	MCR 43	MCR 43	MCR 43	MCR 43	311
	8610.	8610	8610	8610	MAGNA-
3	4610	4610	4610	4610	GLASS 77
	(REC)	PORTER	PORTER	PORTER	4610
	DUPONT	311	311	311	PORTER
	931	MCR 43	MCR 43	MCR 43	311
	823HB	4610	4610	4610	MCR 43
2	326BB				4610
	PORTER	DUPONT	(REC)	(REC)	(REC)
	311	931	DUPONT	DUPONT	DUPONT
	823HB	823HB	931	931	931
	369HB	369HB	823HB	823HB	823HB
1			(REC)	(REC)	(REC)
	DUPONT	DUPONT	DUPONT	DUPONT	DUPONT
	931	931	931	931	931
	823BB	823BB	823BB	823BB	823BB
	326BB	326BB	326BB	369HB	369HB



A

B

C

D

E

5 : SUBOX
 : GALV 5
 : 8500
 : 3100

: SUBOX
 : GALV 5
 : 8500
 : 3100

: (REC)
 : SCBOX
 : GALV 5
 : 4551
 : 3100

: (REC)
 : SUBOX
 : GALV 5
 : 4551
 : 3100

: (REC)
 : SUBOX
 : GALV 5
 : 4551
 : 3100

4 : SUBOX
 : GALV 5
 : 8051
 : 3000

: SUBOX
 : GALV 5
 : 8051
 : 3000

: SUBOX
 : GALV 5
 : 8051
 : 3000

: SUBOX
 : GALV 5
 : 8500
 : 3100

: SUBOX
 : GALV 5
 : 8500
 : 3100

3 : KOPPERS
 : 701
 : HIGARD
 : 1122BRS

: SUBOX
 : GALV 5
 : 8051
 : 3000

2 : SIGMA
 : 7551
 : 5434(H)
 : 7523

: KOPPERS
 : 701
 : 654
 : 1122BRS

: KOPPERS
 : 701
 : 654
 : 1122BRS

: KOPPERS
 : 701
 : 654
 : 1122BRS

: KOPPERS,
 : 701
 : 654
 : 1122BRS

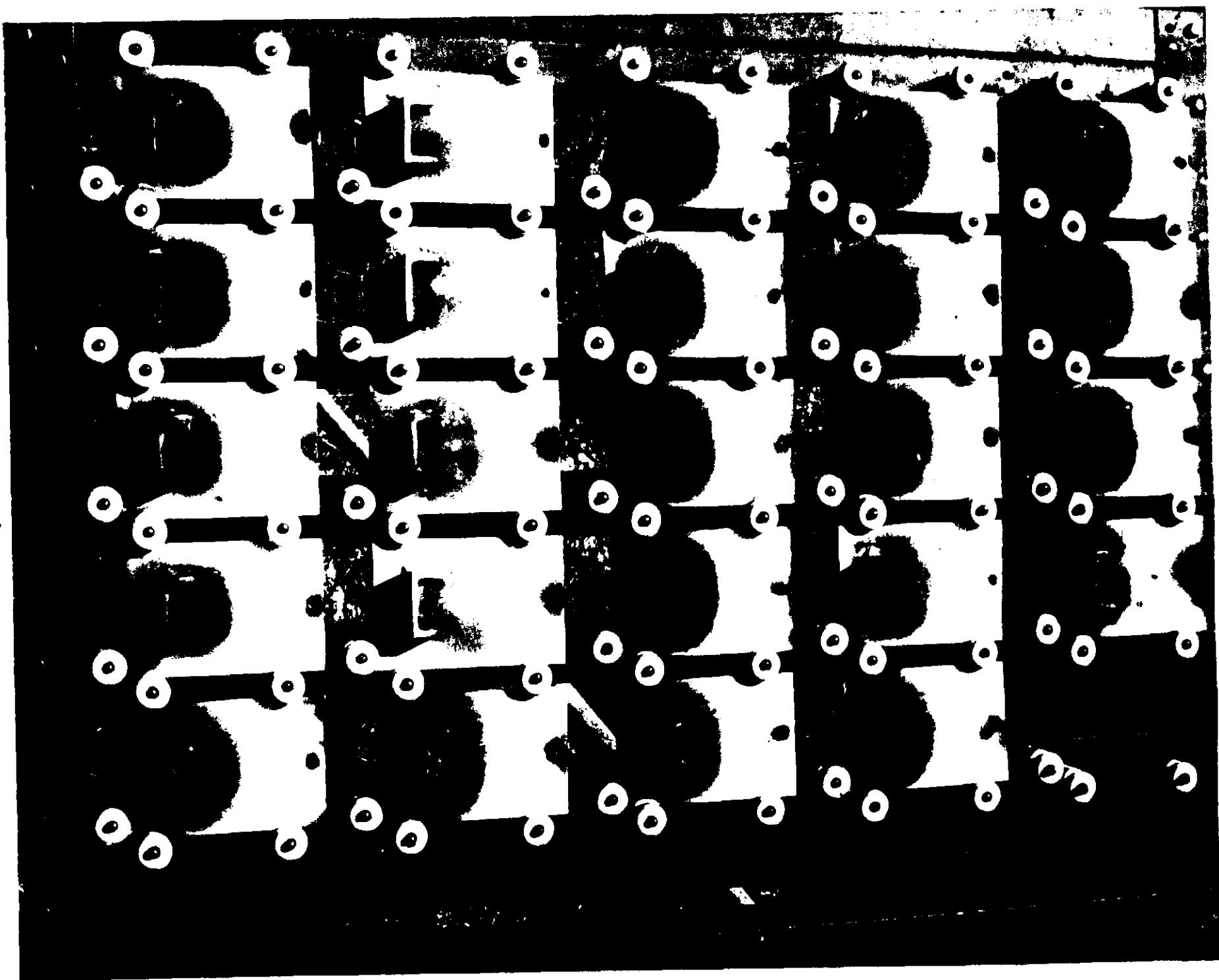
1 : SIGMA
 : 7551
 : 5434(L)
 : 7523

: SIGMA
 : 7551
 : 5434(L)
 : 7523

: SIGMA
 : 7551
 : 5434(H)
 : 7523

: SIGMA
 : 7551
 : 5434(H)
 : 7523

: SIGMA
 : 7551
 : 5434(H)
 : 7523



S'TUDY'NO.: MTB 268-86 RACK NO.: 16A

DATE : 5/91

EXPOSURE: TOPCOAT-ACID

A

B

C

D

E

5 : GLIDDEN:
 : 5536
 : 5461
 : 6252

4 : CONLUX
 : 21
 : E-39
 : A-200.

3 : CONLUX
 : 21
 : E-20
 : A-200

2 : NAPKO
 : 52
 : 520
 : 295

1 : NAPKO
 : 52
 : 516
 : 290

5 : GLIDDEN:
 : 5536
 : 5461
 : 6252

4 : CONLUX
 : 21
 : E-39
 : A-200

3 : CONLUX
 : 21
 : E-20
 : A-200

2 : NAPKO
 : 5Z
 : 520
 : 295

1 : NAPKO
 : 5Z
 : 516
 : 290

5 : GLIDDEN:
 : 5536
 : 5461
 : 6252

4 : CONLUX
 : 21
 : E-39
 : A-200

3 : CONLIJX
 : 21
 : E-20
 : A-200

2 : NAPKO
 : 5Z
 : 520
 : 2.95

1 : NAPKO
 : 5Z
 : 516
 : 290

5 : GLIDDEN:
 : 5536
 : 5461
 : 6252

4 : CONLUX
 : 21
 : E-39
 : A-200

3 : CONLUX
 : 21
 : E-20
 : A-200

2 : NAPKO
 : 5Z
 : 520
 : 2.95

1 : NAPKO
 : 5Z
 : 516
 : 290

5 : GLIDDEN:

4 : GLIDDEN:

3 : GLIDDEN:

2 : GLIDDEN:

1 : GLIDDEN:

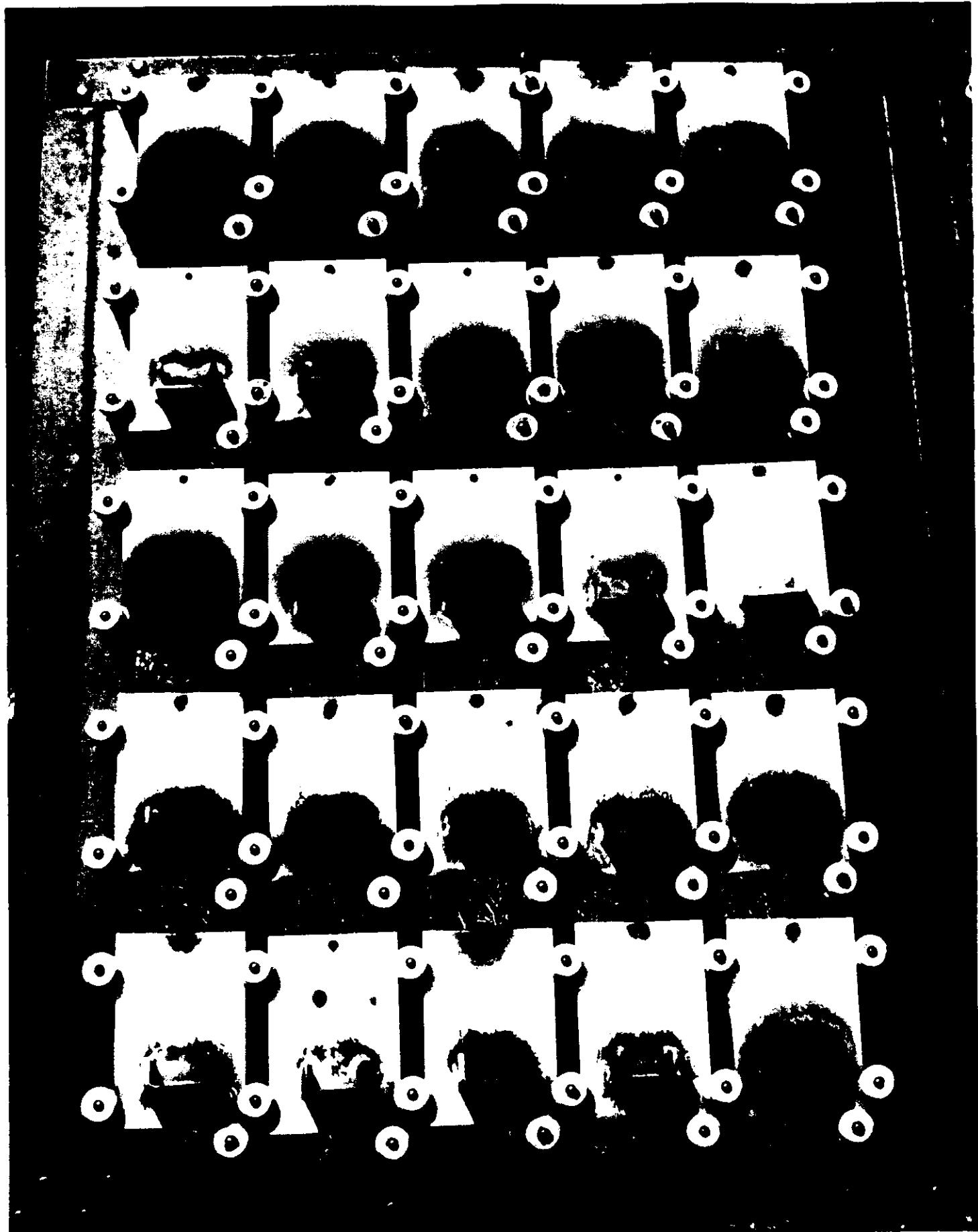
E

5 : GLIDDEN:
 : 5530
 : 5461
 : 6252

3 : GLIDDEN:
 : 5530
 : 5461
 : 6252

2 : GLIDDEN:
 : 5530
 : 5461
 : 6252

1 : GLIDDEN:
 : 5530
 : 5461
 : 6252



STUDY NO.: MTB 268-86 RACK NO.: 16B DATE : 5/91

EXPOSURE: TOPCOAT-ACID

A

B

C

D

E

5
: CEILCOTE
: 200
: EP675
: 470-01
:
:

: CEILCOTE
: 200
: EP675
: 470-01
:
:

: CEILCOTE
: 200
: EP675
: 470-01
:
:

: CEILCOTE
: 200
: EP675
: 470-01
:
:

: CEILCOTE
: 200
: EP690
: 470-01
:
:

4
: PPG
: 1001
: 97-130
: 97-812
:
:

: (REC)
: PPG
: 1001
: 97-148
: 97-812
:
:

: (REC)
: PPG
: 1001
: 97-148
: 97-812
:
:

: (REC)
: PPG
: 1001
: 97-148
: 97-812
:
:

: CEILCOTE
: 200
: EP690
: 470-01
:
:

3
: PPG
: 1001
: 97-3
: 97-812
:
:

: PPG
: 1001
: 97-3
: 97-812
:
:

: PPG
: 1001
: 97-3
: 97-812
:
:

: PPG
: 1001
: 97-130
I: 97-812
:
:

: FFG
: 1001
: 97-130
: 97-812
:
:

2
: GLIDDEN:
: 5530
: 5555
: HBU
:
:

: GLIDDEN:
: 5530
: 5555
: HBU
:
:

: GLIDDEN:
: 5530
: 5555
: HBU
:
:

: GLIDDEN:
: 5530
: 5555
: HBU
:
:

: (REC)
: CONLUX
: 21
: w-17
: v-93
: V-98
:
:

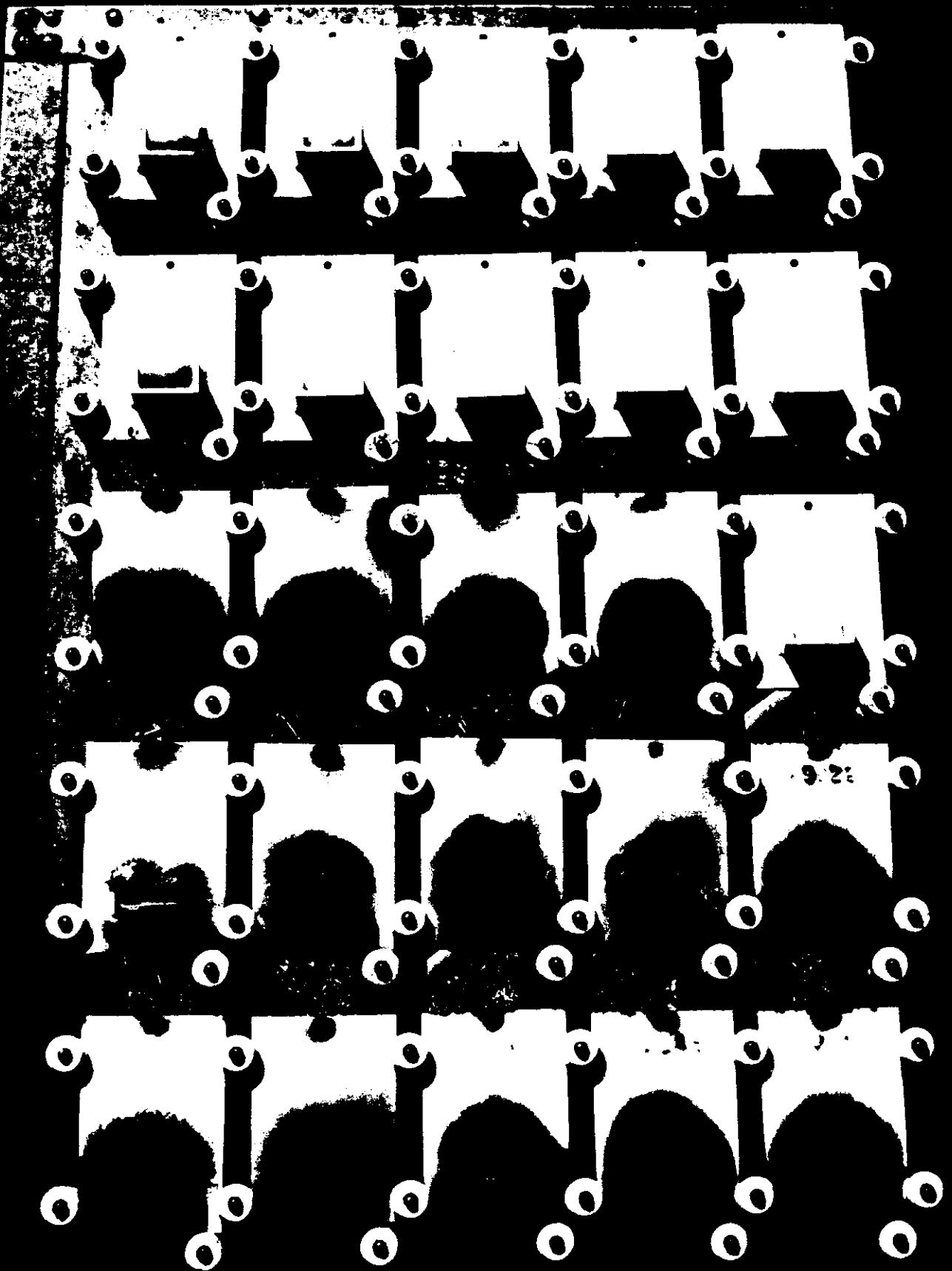
1
: GLIDDEN:
: 5536
: 5555
: HBU
:
:

: GLIDDEN:
: 5536
: 5555
: HBU
:
:

: GLIDDEN:
: 5536
: 5555
: HBU
:
:

: GLIDDEN:
: 5536
: 5555
: HBU
:
:

: (REC)
: CONLUS
: 21
: w-47
: v-93
: V-98
:
:



A

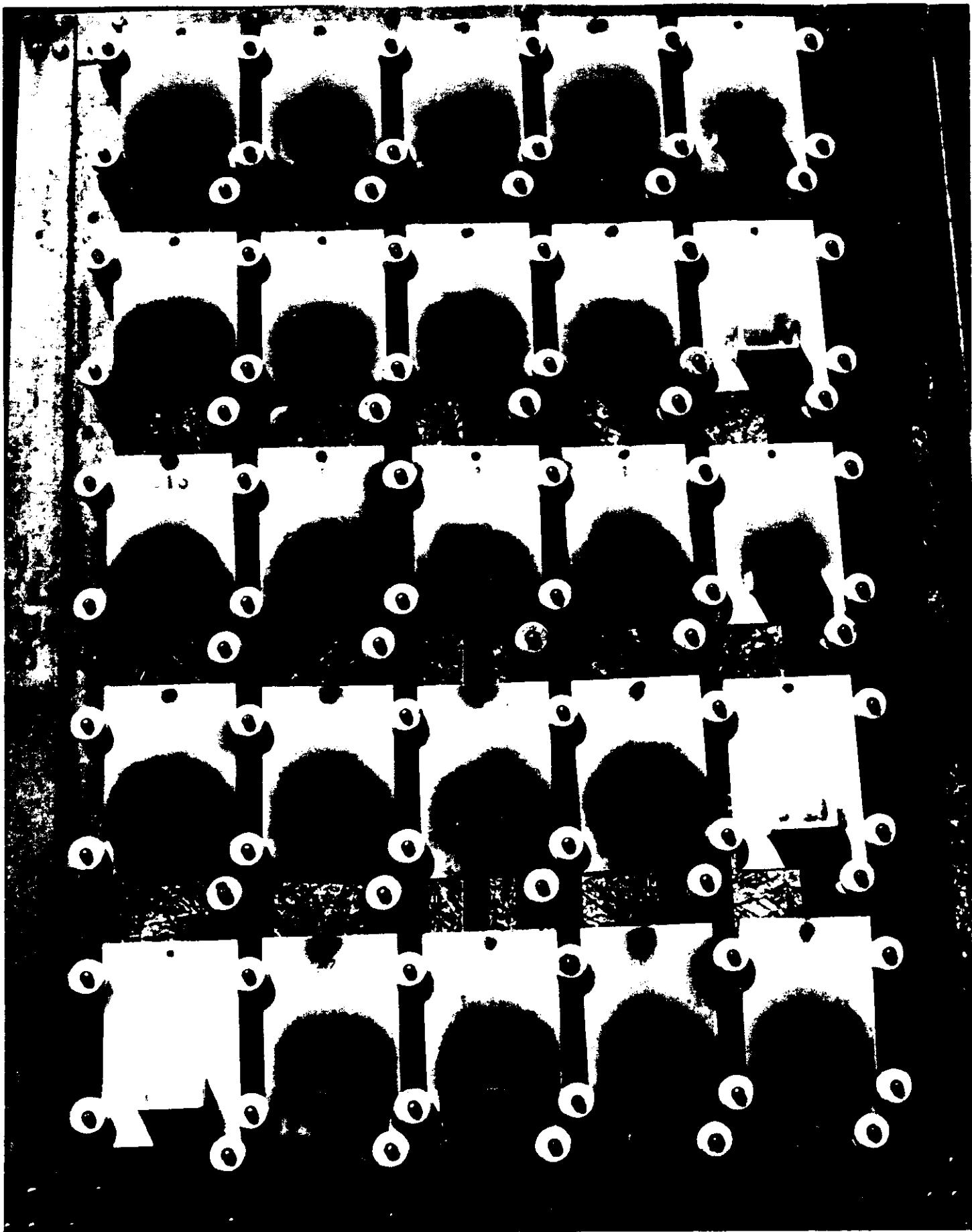
B

C

D

E

5	DEVOE-	DEVOE-	DEVOE-	DEVOE-	(REC)
	MARINE	MARINE	MARINE	MARINE	MARINE
	304	304	304	304	304
	230	230	230	230	201
	249	249	249	249	249
4	DEVOE-	DEVOE-	DEVOE-	DEVOE-	(REC)
	MARINE	MARINE	MARINE	MARINE	MARINE
	304	304	304	304	304
	201	201	201	201	201
	239	239	239	239	249
3	(REC)	(REC)	(REC)	(REC)	(REC)
	CARBO	CARBO	GARBO	CARBO	DEVOE-
	CZ-11	cz-11	cz-11	cz-11	MARINE
	188HB	188HB	188HB	188HB	304
	134	134	134	134	201
2	CARBO	CARBO	CARBO	CARBO	CARBO
	CZ-11	cz-11	CZ-11	CZ-11	cz-11
	190HB	190HB	190HB	190HB	193LF
	133HB	133HB	133HB	133HB	134
1	CEILCOTE	CEILCOTE	CARBO	CARBO	CARBO
	200	200	cz-11	cz-11	cz-11
	EP690	EP690	193LF	193LF	193LF
	470-01	470-01	134	134	134



A

B

C

D

E

3	: YOBIL	: MOBIL
	: ZINC 7	: ZINC 7
	: 13-R-60;	: 13-R-60;
	40	40

: MOBIL
: ZINC 7
: 13-R-60;
40

: YOBIL
: ZINC 7
: 13-R-60
40

: MOBIL
: ZINC 7
78
11

4	: SHERWIN-	: SHERWIN-
	: WILLIAMS	: WILLIAMS
	: ZINCLAD	: ZINCLAD
	: HI SOLID	: HI SOLID
	: HI BILD	: HI BILD

: SHERWIN-
: WILLIAMS
: ZINCLAD
: HI SOLID
: HI BILD

: SHERWIN-
: WILLIAMS
: ZINCLAD
: HI SOLID
: HI BILD

: YOBIL
: ZINC 7
78
41

3	:	:
	: SHERWIN-	: SHERWIN-
	: WILLIAMS	: WILLIAMS
	: ZINCLAD	: ZINCLAD
	: TILECLAD	: TILECLAD
	: POLANE	: POLANE

:
: SHERWIN-
: WILLIAMS
: ZINCLAD
: TILECLAD
: POLANE

:
: SHERWIN-
: WILLIAMS
: ZINCLAD
: TILECLAD
: POLANE

: MOBIL
: ZINC 7
78
41

2	:	:
	: TNEMEC	: TNEMEC
	: 90E-75	: 90E-75
	: 66(H)	: 66(H)
	73	73

:
: TNEMEC
: 90E-75
: 66(H)
73

:
: TNEMEC
: 90E-75
: 66(H)
73

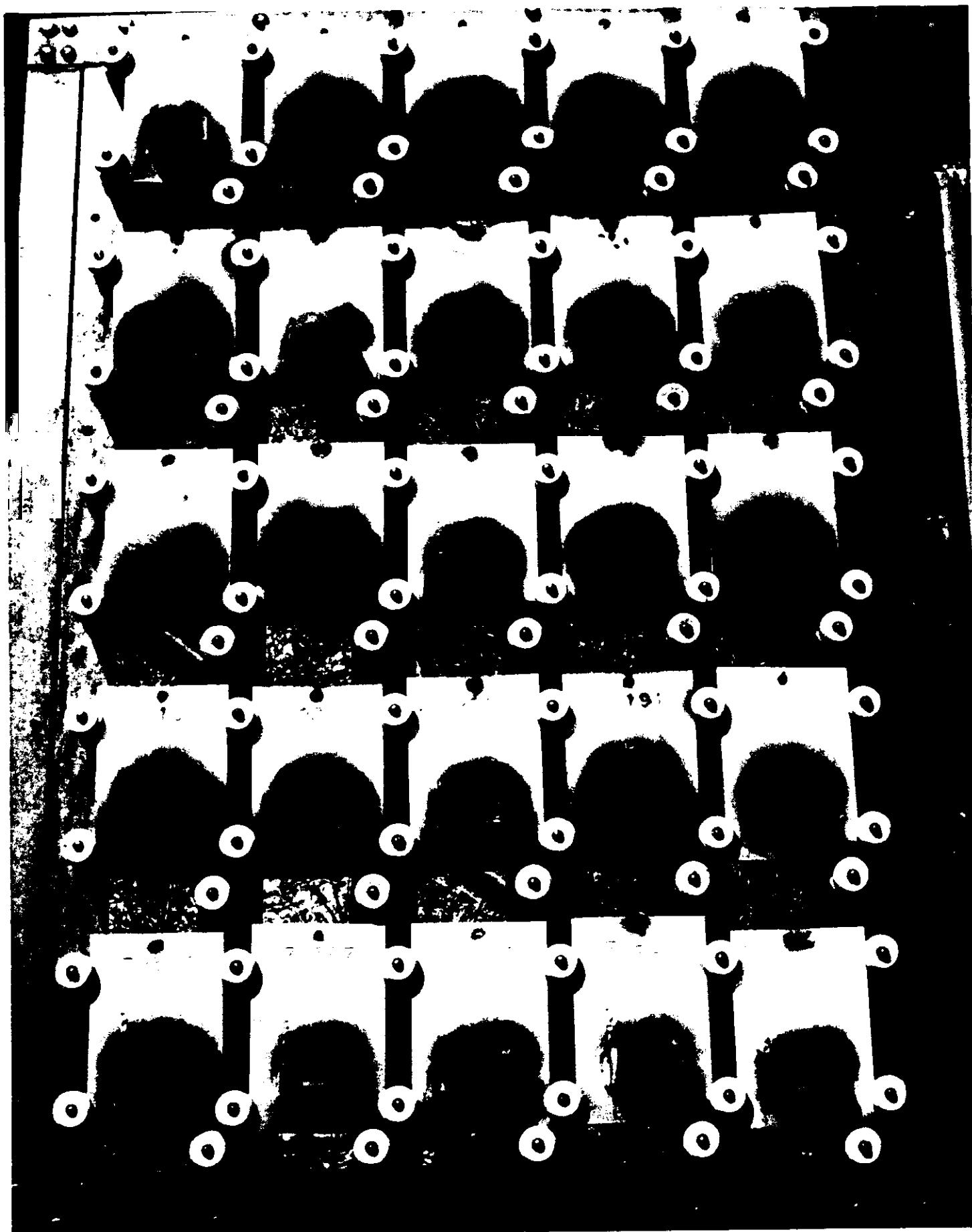
: YOBIL
: ZINC 7
78
41

1	: (REC)	: TNEMEC
	: DEVOE-	: 90E-75
	: MARINE	: 66(L)
	304	70
	201	
	249	

:
: TNEMEC
: 90E-75
: 66(L)
70

:
: TNEMEC
: 90E-75
: 66(L)
70

: TNEMEC
: 90E-75
: 66(L)
70



STUDY NO.: MTB 268-86 RACK NO.: 19C DATE : 5/91 EXPOSURE: TOPCOAT-ACID

A

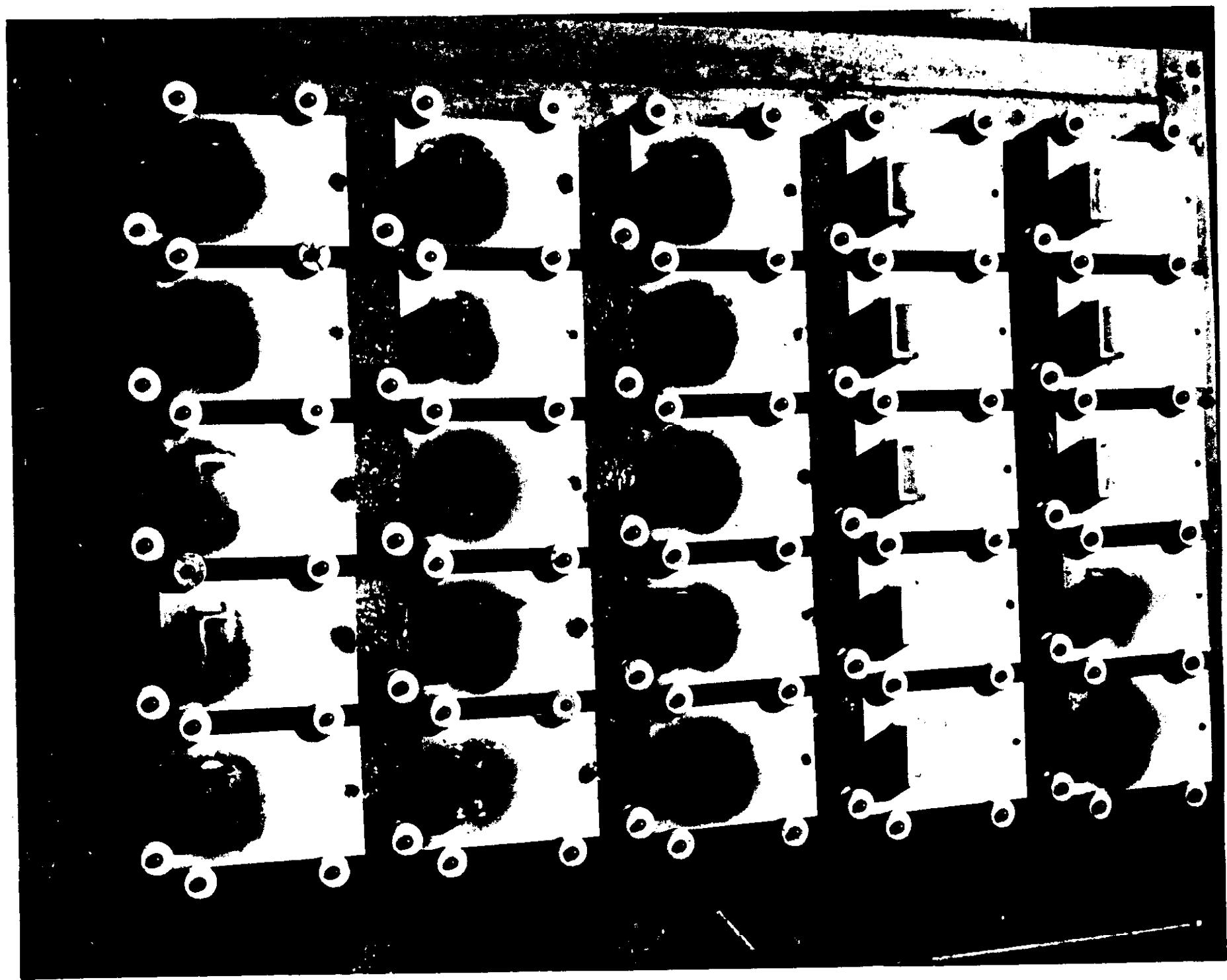
B

C

D

E

5	: CORONADO : 935-152 : 101-147 : 827-i : :			
4	: (REC) : INTER- : ZINC : TAA423 : PHBOOO : :			
3	: INTER- : ZINC : EXA008 : PHBOOO : :			
2	: INTER- : ZINC : 745 : PCB000 : :			
1	: (REC) : MOBIL : ZINC 7 : a3 : 22 : :	: (REC) : MOBIL : ZINC 7 : 83 : 22 : :	: (REC) : MOBIL : ZINC 7 : 83 : 22 : :	: (REC) : MOBIL : ZINC 7 : a3 : 22 : :



STUDY NO.: MTB 268-86 RACK NO.: 20A DATE : 5/91

EXPOSURE: TOPCOAT-ACID

A**B****C****D****E**

5 : ((REC)
: PORTER
: 311
: MAGNA-
: GLASS 77
: 4610

: (REC)
: PORTER
: 311
: MAGNA-
: GLASS 77
: 4610

: (REC)
: PORTER
: 311
: MAGNA-
: GLASS 77
: 4610

: SIGMA
: 7551
: 5434(L)
: 7523

: SIGMA
: 7551
: 5434(L)
: 7523

4 : PORTER
: 311
: MCR 43
: 8610

: PORTER
: 311
: MCR 43
: 8610

: PORTER
: 311
: MCR 43
: 8610

: PORTER
: 311
: MCR 43
: 8610

: (REC)
: PORTER
: 311
: MAGNA-
: GLASS 77
: 4610

3 : (REC)
: DUPONT
: 931
: 823HB
: 326BB

: PORTER
: 311
: MCR 43
: 4610

: PORTER
: 311
: MCR 43
: 4610

: PORTER
: 311
: MCR 43
: 4610

: PORTER
: 311
: MCR 43
: 4610

2 : DUPONT
: 931
: 823HB
: 369HB

: DUPONT
: 931
: 823HB
: 369HB

: (REC)
: DUPONT
: 931
: 823HB
: 326BB

: (REC)
: DUPONT.
: 931
: 823HB
: 326BB

: (REC)
: DUPONT
: 931
: 823HB
: 326BB

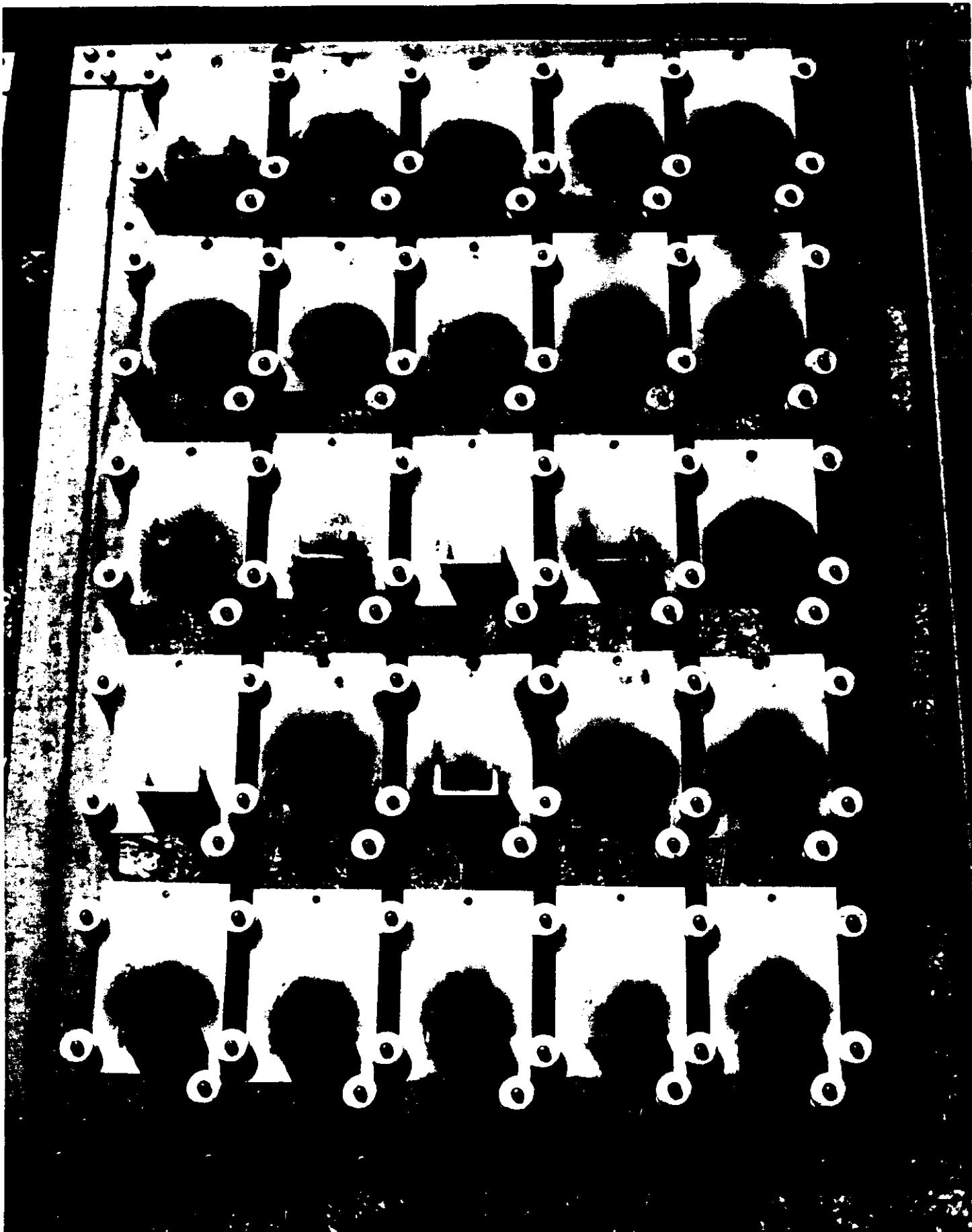
1 : DUPONT
: 931
: 823BB
: 326BB

: DUPONT
: 931
: 823BB
: 326BB

: DUPONT
: 931
: 823BB
: 326BB

: DUPONT
: 931
: 823HB
: 369HB

: DUPONT
: 931
: 823HB
: 369HB



STUDY NO.: MTB 268-86 RACK NO.: 20B DATE : 5/91 EXPOSURE: TOPCOAT-ACID

A

B

C

D

E

5
: SUBOX
: GALV 5
: 8500
: 3100

: SUBOX
: GALV 5
: 8500
: 3100

: (REC)
: SUBOX
: GALV 5
: 4551
: 3100

: (REC)
: SUBOX
: GALV 5
: 4551
: 3100

: (REC)
: SUBOX
: GALV 5
: 4551
: 3100

4
: SUBOX
: GALV 5
: 8051
: 3000

: SUBOX
: GALV 5
: 8051
: 3000

: SUBOX
: GALV 5
: 8051
: 3000

: SUBOX
: GALV 5
: 8500
: 3100

: SUBOX
: GALV 5
: 8500
: 3100

e-v

3
: KOPPERS:
: 701
: HIGARD
: 1122BRS

: SUBOX
: GALV 5
: 8051
: 3000

2
: SIGMA
: 7551
: 5434(H)
: 7523

: KOPPERS
: 701
: 654
: 1122BRS

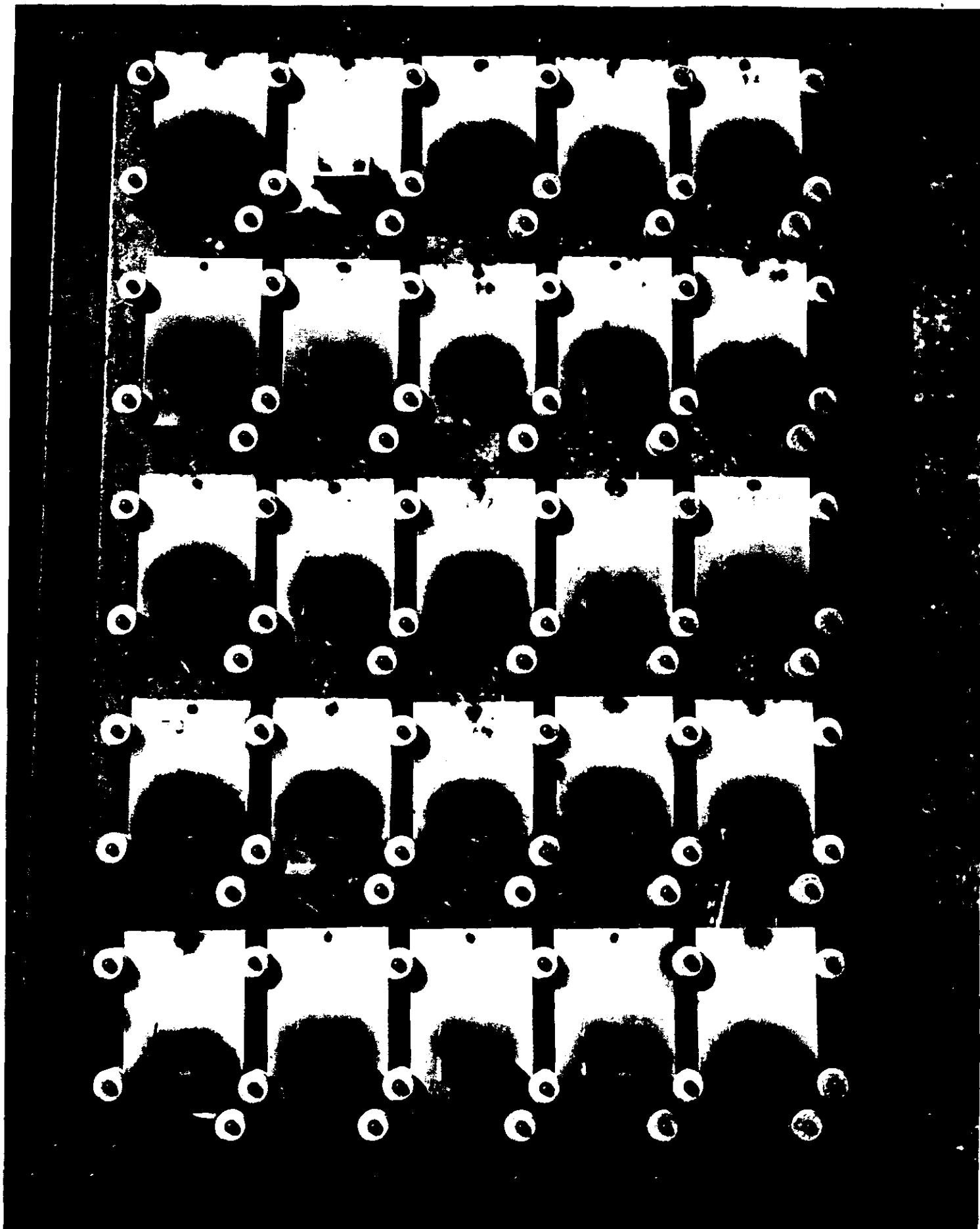
1
: SIGMA
: 7551
: 5434(L)
: 7523

: SIGMA
: 7551
: 5434(L)
: 7523

: SIGMA
: 7551
: 5434(H)
: 7523

: SIGMA
: 7551
: 5434(H)
: 7523

: SIGMA
: 7551
: 5434(H)
: 7523



STUDY NO.: MTB 268-86 RACK NO.: 20C

DATE : 5/91

EXPOSURE: TOPCOAT-ACID

A

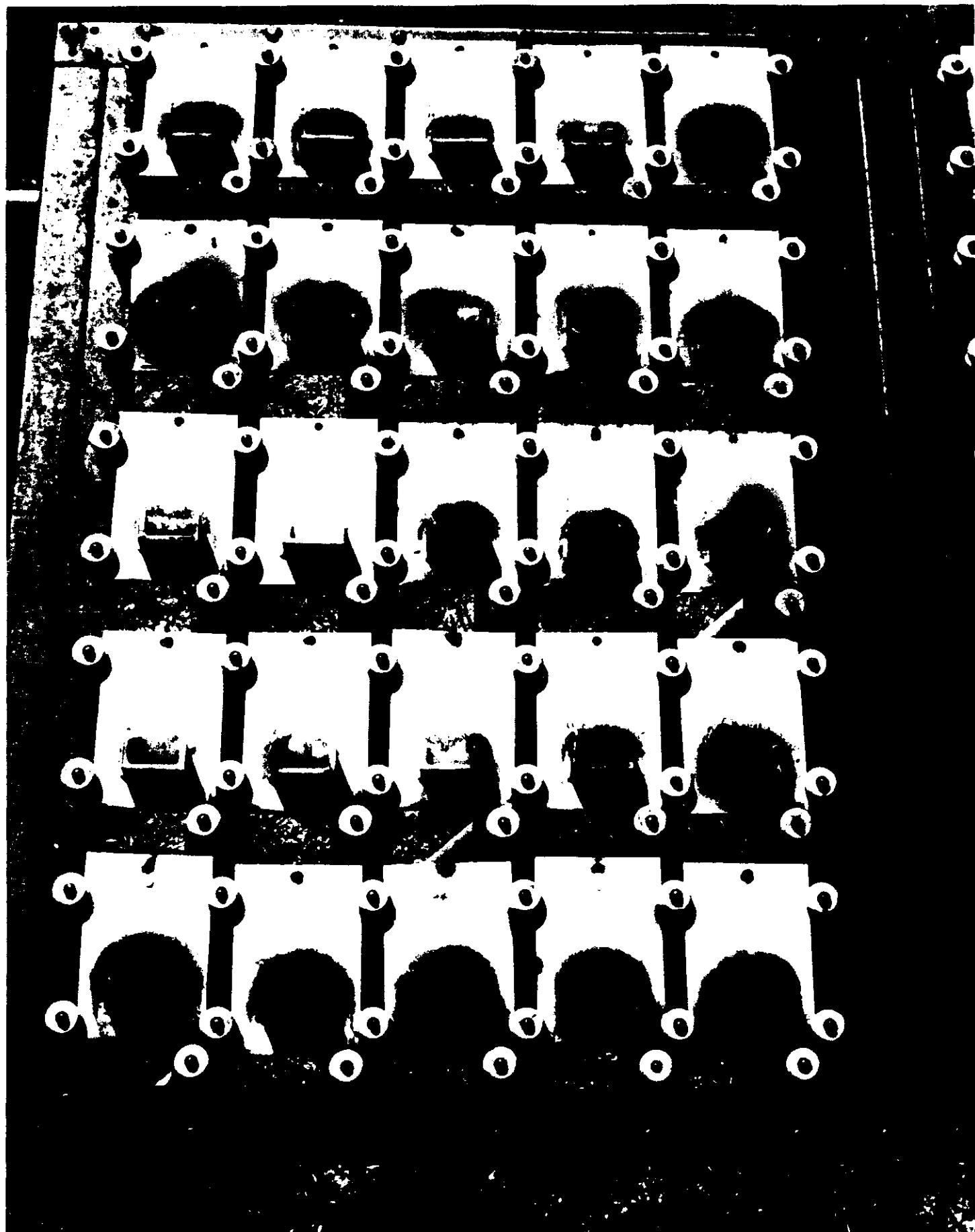
B

C

D

E

5	: AMERON : D-6N : 383HS : 2490	: (REC) : AMERON : D-6N : 400 : 2490	: (REC) : AMERON : D-6N : 400 : 2490	: (REC) : XMERON : D-6N : 400 : 2490
4	: AMERON : D-6N : 182 : 450GL	: AMERON : D-6N : 182 : 450GL	: AMERON : D-6N : 383HS : 2490	: AMERON : D-6N : 383HS : 2490
3	: (REC) : AMERON : D-9 : 400 : 2490	: (REC) : AMERON : D-9 : 400 : 2490	: (REC) : AMERON : D-9 : 400 : 2490	: AMERON : D-6N : 182 : 450GL
2	: AMERON : D-9 : 383HS : 2490	: AMERON : D-9 : 383HS : 2490	: AMERON : D-9 : 383HS : 2490	: (REC) : AMERON : D-9 : 400 : 2490
1	: (REC) : SUBOX : GALV 5 : 4551 : 3100	: AMERON : D-9 : 182 : 450GL	: AMERON : D-9 : 182 : 450GL	: AMERON : D-9 : 182 : 450GL



STUDY NO.: MTB 268-86 RACK NO.: 21A DATE : 5/91

EXPOSURE: TOPCOAT-ACID

A

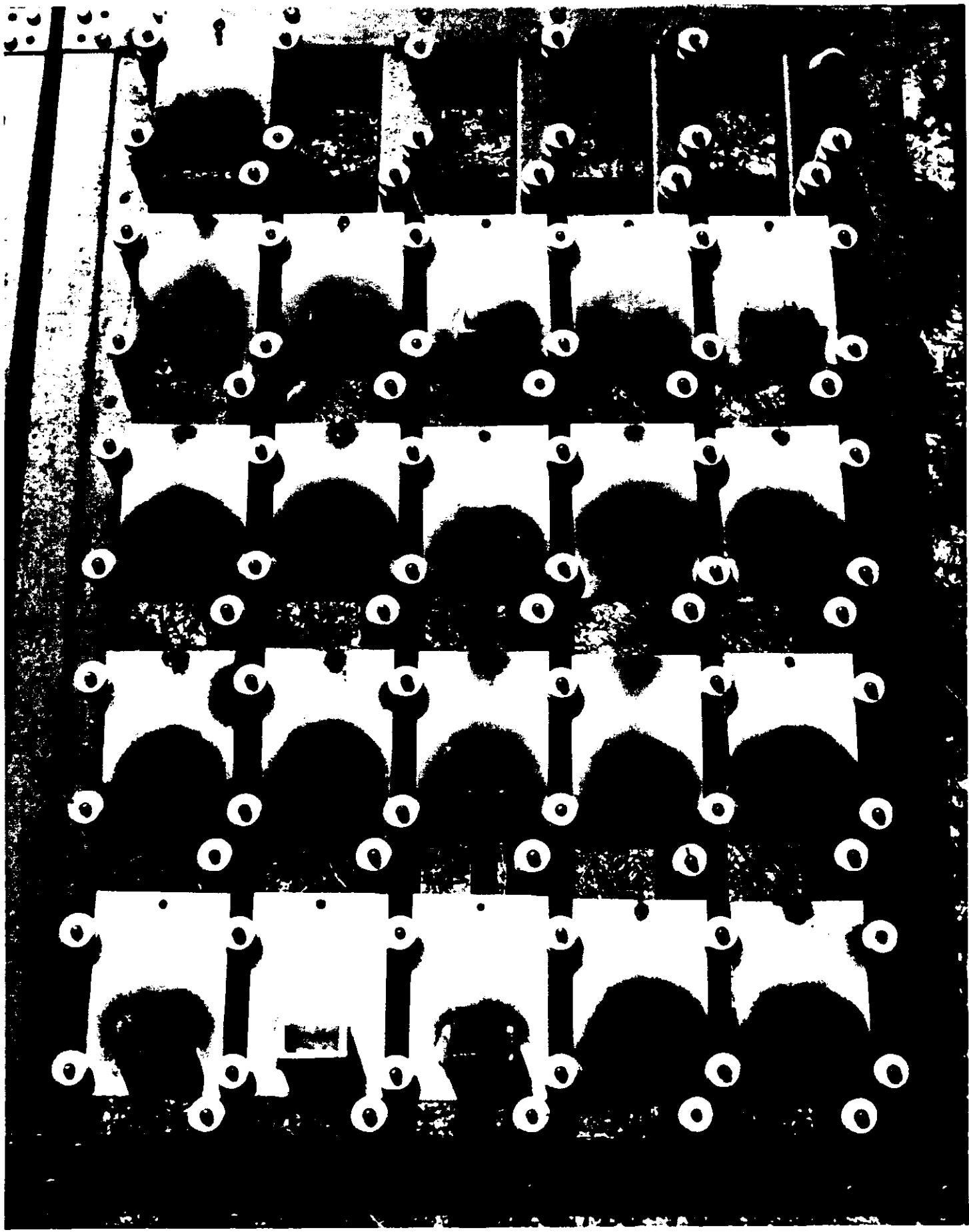
B

C

D

E

5	: ENGARD : 519 : 1447(L) : 449 I	: ENGXR D : 519 : 1447(L) : 449	: ENGARD : 519 : 1447(L) : 449	: ENGARD : 519 : 1447(L) : 449
	: DEVOE- : PRUFCOAT : Z.P.500 : 545 : 369	: DEVOE- : PRUFCOAT : Z.P.500 : 547 : 359	: DEVOE- : PRUFCOAT : Z.P.500 : 547 : 359	: DEVOE- : PRUFCOAT : Z.P.500 : 547 : 359
	: (REC) : RUST- : OLEUM : 5686 : 95-1501 : 9400	: (REC) : RUST- : OLEUM : 5686 : 95-1501 : 9400	: DEVOE- : PRUFCOAT : Z.P.500 : 545 : 369	: DEVOE- : PRUFCOAT : Z.P.500 : 545 : 369
	: RUST- : OLEUM : 5686 : 9582 : 9400	: RUST- : OLEUM : 5686 : 9582 : 9400	: RUST- : OLEUM : 5686 : 9582 : 9400	: (REC) : RUST- : OLEUM : 5686 : 95-1501 : 9400
	: RUST- : OLEUM : 5686 : 9373 : 9400	: RUST- : OLEUM : 5686 : 9373 : 9400	: RUST- : OLEUM : 5686 : 9373 : 9400	: (REC) : RUST- : OLEUM : 5686 : 9582 : 9400
1				



A

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E

5
: DEVOE-
: NAPKO
: 2Z
: 547
: 359

4
: DEVOE-
: NAPKO
: 2Z
: 545
: 369

3
: SUBOX
: GALV 4
: 8500
: 3100

2
: SUBOX
: GALV 4
: 8051
: 3000

1
: ENGARD
: 519
: 1447(H)
: 428

4
: DEVOE-
: NAPKO
: 2Z
: 545
: 369

3
: SUBOX
: GALV 4
: 4551
: 3100

2
: SUBOX
: GALV 4
: 8051
: 3000

1
: ENGARD
: 519
: 1447(H)
: 428

: DEVOE-
: NAPKO
: 2Z
: 545
: 369

: (REC)
: SUBOX
: GALV 4
: 4551
: 3100

: SUBOX
: GALV 4
: 8500
: 3100

: ENGARD
: 519
: 1447(H)
: 428

: DEVOE-
: NAPKO
: 2Z
: 547
: 359

: (REC)
: SUBOX
: GALV 4
: 4551
: 3100

: SUBOX
: GALV 4
: 8500
: 3100

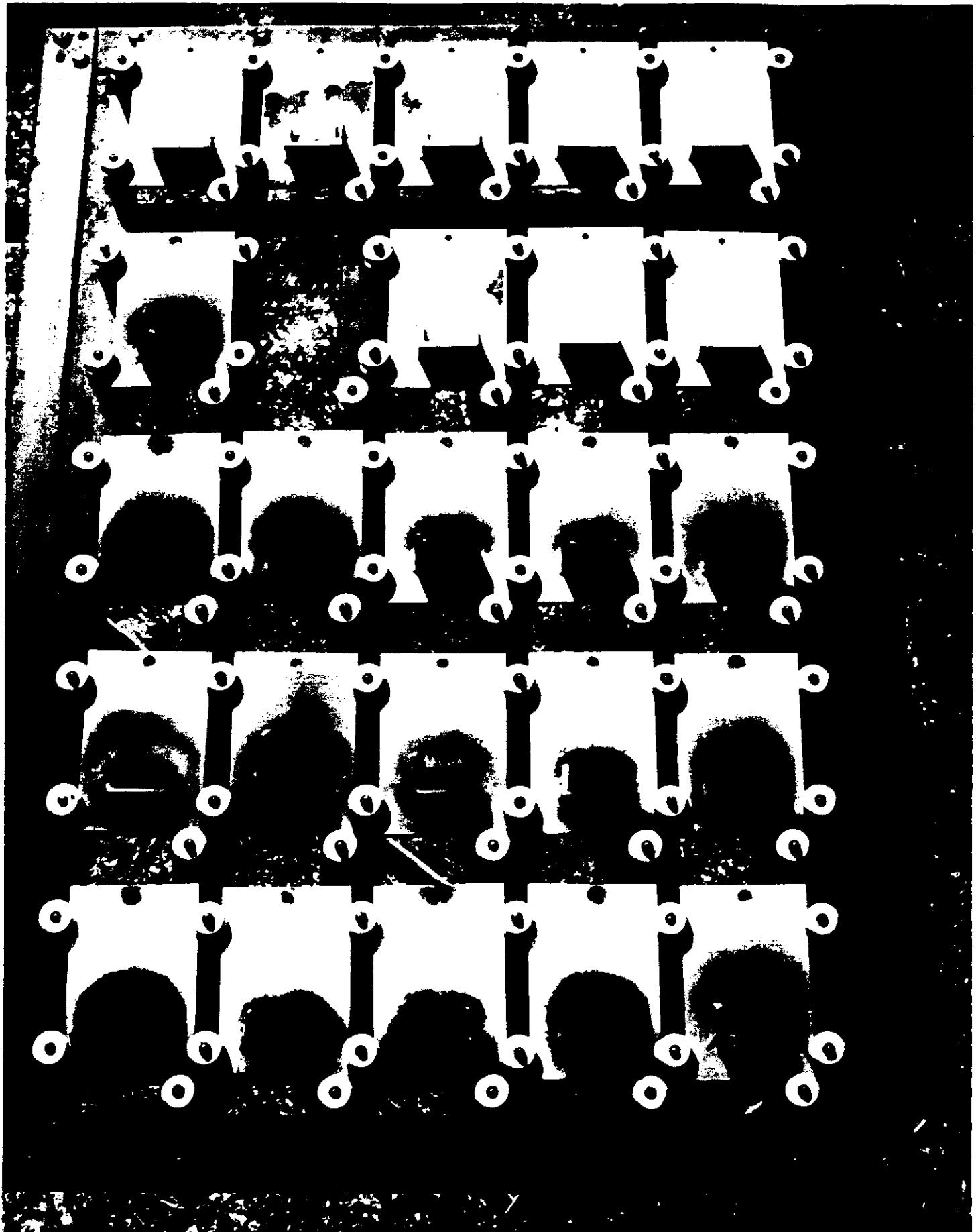
: SUBOX
: GALV 4
: 8051
: 3000

: DEVOE-
: NAPKO
: 22
: 547
: 359

: (REC)
: SUBOX
: GALV 4
: 4551
: 3100

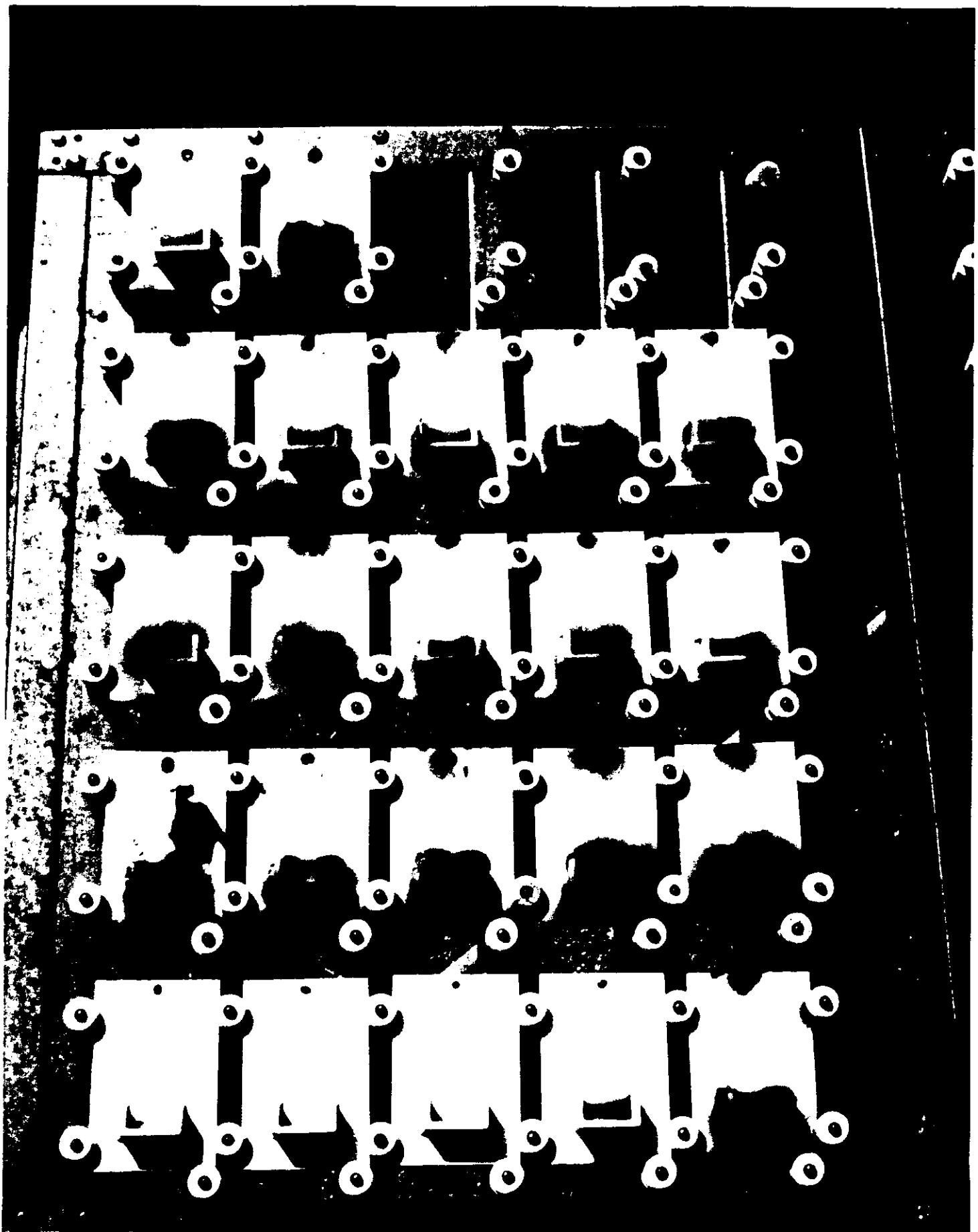
: SUBOX
: GALV 4
: 8500
: 3100

: SUBOX
: GALV 4
: 8051
: 3000



91-4821

APPENDIX



STUDY NO.: MTB 268-86 RACK NO.: 3A

DATE : 5/9

EXPOSURE: ZINC - NORMAL

A

B

C

D

E

5

: A?ERON

: AMERON

: AMERON

: AMERON

: AMERON

: D-9

: D-9

: D-9

: D-9

: D-6N

4

: RUST

: RUST

: RUST

: RUST

: AMERON

: OLEUM.

: OLEUM

: OLEUM

: OLEUM

: D-6N

: 5686

: 5686

: 5686

: 5686

3

: DEVOE

: DEVOE

: DEVOE

: DEVOE

: AMERON

: PRUFCOAT

: PRUFCOAT

: PRUFCOAT

: PRUFCOAT

: D-6N

: Z.P.

: Z.P.

: Z.P.

: Z.P.

: 500

: 500

: 500

: 500

: 500

2

: SUBOX

: SUBOX

: SUBOX

: SUBOX

: AMERON

: GALV 4

: GALV 4

: GALV 4

: GALV 4

: D-6N

1

: SUBOX

: SUBOX

: SUBOX

: SUBOX

: :

: GALV 5

: GALV 5

: GALV 5

: GALV 5

: :

